ENTOMOLOGICAL RESEARCH IN BRITISH WEST AFRICA.

III.—SOUTHERN NIGERIA.

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(*With a Map showing the distribution of* Glossina *and photographs by the author.*)

(Plates II—V.)

Contents.

Introductory.

The Colony of Southern Nigeria was traversed by the writer in 1910, and the following short report is founded on observations made during the first seven months of that year. As will be seen later on, various officers, chiefly medical, stationed in the Colony, afforded material help in the investigation, and the results of their work are also incorporated here; the collections of injurious insects made by them have been duly acknowledged in previous issues of this Bulletin, and also, as far as possible, throughout this report.

A word of explanation is necessary in order to avoid any misapprehension of the aims of the writer in framing this résumé. The report deals entirely with the blood-sucking insects and other arthropods which are or may be associated with the various parasitic diseases found in this and similar Colonies. As in the case of all Tropical African dependencies, prior to the formation of the Entomological Research Committee, very little was known of the economic entomological fauna. Through the instrumentality of the Medical Research Institute at Yaba (five miles from Lagos), Southern Nigeria is probably ahead of most other Colonies in this respect. Considerable work has been done there, chiefly on mosquito larvae, but this work has been confined almost entirely to Yaba and Lagos, a very circumscribed area.

The primary aim of the Entomological Research Committee, so far as Tropical Africa is concerned, may be tersely summed up as "a complete study of the insects and other arthropods implicated in the transmission of diseases in man and other animals."

Unfortunately, at present, it is not possible to detail with certainty, except in a few special cases, which diseases are insect-borne and which are not. Further, although certain insects have been proved to be the carriers of particular diseases, it is far from certain that other allied species may not also be implicated. For example, it is now known that *Glossina palpalis* and *G. morsitans* transmit sleeping sickness from man to man, yet it is not possible to say whether only these species of *Glossina* or only this genus may be capable of transmitting it. Again, in the case of malaria, we know that this disease is transmitted by Anopheline mosquitos, but of these there are many species, and, with the exception of a very few, no definite statement can be made as to which are or are not innocuous. A third example is yellow fever. It is well known that *Stegomyia fasciata* transmits this disease, but as to whether this is the only species capable of such transmission no one will at present venture to say. Another disease, unfortunately by no means uncommon in Southern Nigeria, is "Calabar swelling" —but of the etiology of this malady practically nothing is known beyond the fact that it is probably insect-borne. The same may be said of elephantiasis; and doubtless there are other maladies which, though at present not thus associated, may eventually prove to be disseminated by insects.

Enough has been said to emphasise the necessity for much experimental work, and it is towards the stimulation of an interest in the entomological aspect of such investigations that the efforts of this Committee are mainly directed.

The first step in such an enquiry must naturally be a mapping out of the various endemic centres of the different diseases, combined with a similar study of the distribution of the various blood-sucking insects. Always remembering that every blood-sucking arthropod is, so far as we know, a potential disease-carrier, one must carefully record the distribution of each and every species. When this has been done, it is more than probable that such maps, when superimposed, may give valuable clues as to the inter-relationship of certain diseases with certain species of insects. This then is one of the first problems to be solved.

Our ignorance of such distribution is not due to any lack of interest or desire on the part of the various officials, but in most cases to a lack of material for collecting and preserving, or to the difficulty of obtaining identifications of unfamiliar species when collections have been made. Such collecting should always involve the recording of observations, such as the nature of the habitat, *e.g.*, whether the species is found in the open, associated with bush, in houses, near water, etc., the season of the year, the weather conditions, the time of the day, and so on. An endeavour should also be made to ascertain the breeding-places, the different immature stages, and the nature of the food supply, in fact, everything which is essential or detrimental to the existence of the various species. This will form the basis for prophylactic measures and will also help to indicate along what lines insect-borne diseases may be expected to spread, and so be a means of preventing any extension of the endemic areas.

It is obviously useless for any one to carry on transmission experiments, to dissect for parasites or such-like, unless he is perfectly certain of the species with which he is dealing, so that the second step in this work is identification.

From what has been said, it will be seen that such investigations can be effected only by those stationed for a considerable time in one place, and further, that it is important that these observations should be made at as many places as possible and continuously throughout the different seasons. Consequently, it has been the aim of the Committee to stimulate interest in this work and to help to overcome the difficulties which confronted many who had previously directed considerable attention to this subject.

Instructions and apparatus for collecting were distributed to the various stations; collections made in these districts were identified and the names of the various species sent to the different collectors, along with named specimens where desired, so that it is hoped that eventually in each station there will be a named collection of all the economic insects found in the district. The Bulletin serves as a medium for recording observations, and any notes or papers, however short, bearing on any aspect of economic entomology are published therein.

A proof of the results of the endeavours of the Committee in this work may be gathered from the number of volunteer workers whose names occur in previous issues of the Bulletin and in this report, and it must be remembered that this work is carried on in spare time after multifarious and ardous duties, often under very trying conditions, and consequently reflects the greatest credit on those men who are thus labouring in the interests of humanity. It is hoped, however, that many who at present are accumulating important observations will give the results of their work more concrete form, in short papers, for the benefit of others interested.

The main object of the writer in order to further this investigation in Southern Nigeria was, therefore, to make as extended a tour as possible, visit the various stations, and so come in contact with those already interested in such work, or, by explaining the aims and methods of the Committee, to secure the co-operation of those who might be persuaded to aid in the scheme. Consequently, it was impossible for the writer to do any actual experimental work or devote any time to the study of life-histories or such-like investigations in any special locality.

The report must, therefore, be considered as a general geographical survey, and taken with other notes and papers published dealing with Southern Nigeria, forms a résumé of recent work. Further, it is hoped that it may serve to show not how much, but how little, is known of this aspect of the subject. Considerable collecting was done, and these records are incorporated along with those of other officials who have from time to time sent specimens from different localities. The arrangement followed is, to a certain extent, different from that adopted in my previous reports on the Gambia * and Northern Nigeria.† I have altogether disregarded the order in which the various parts of the colony were visited, and have considered the region from a general geographical aspect. The route followed is, however, shown on the map which accompanies the report.

The greatest stress has been laid on the factors which influence the distribution of the various species of blood-sucking insects, and in this connection the general

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* Bull. Ent. Res. II, pt. 3, pp. 187–239. † Bull. Ent. Res. II, pt. 4, pp. 301–356.

geographical situation of the colony, the main topographical features, the river and mountain systems, the climate and rainfall, and the various types of vegetation and their distribution, have received consideration.

A short description of the main characteristics of the regions I was unable to visit have also been given, so that when records from these localities come to hand it may be possible to correlate them with others already known as to similarity of environment, climate, etc.

A map has been prepared to show the distribution of the various species of *Glossina* in the colony, and on it are included all available authentic records. A short chapter has also been added emphasising the main features of this distribution.

A list of all the blood-sucking insects, and other arthropods has been drawn up, and though this list is already large, there is little doubt that further work will still augment the number. At the same time, in the case of many of the species, little is known of their general distribution.

A few notes on the different protozoal diseases found in the colony are also given, but our knowledge of the distribution or endemicity of these is far from complete, while, in this connection also, a résumé of what is known of the prevalence of the various species of *Stegomyia* has been added.

In my previous reports I have discussed at some length a few of the many problems which require further investigation, and, as these are equally applicable to Southern Nigeria, there is no necessity for reiterating them. The same holds good with regard to remedial measures and recommendations, so that, with the exception of a few special cases, these have also been excluded from this report.

Sufficient has been said, therefore, to indicate the lines along which this report was possible and on which it has been framed, but I would once more like to point out that, although it was impossible for the writer to attempt to solve any particular problem, it is hoped that this account of the work done, and its general bearing on distribution, may help to stimulate others to an elucidation of the important bearing of insects in their relation to disease, and indicate lines along which such work may be most profitably accomplished. At the same time it may help to show how such difficulties as the identification of insects may be overcome, and also how the most trivial observations may be utilised in the general scheme of knowledge.

I. Geography of the Colony and Protectorate.

(*a*) Position and Extent.

The Colony and Protectorate of Southern Nigeria, one of the oldest and most productive of the British West African Possessions, is situated in the extreme east of the Gulf of Guinea. Its total area is estimated at about 77,500 square miles, or nearly two-thirds of the United Kingdom. Owing to its irregularity in shape, its extreme limits are separated by great distances, *e.g.*, its eastern and western boundaries lie approximately in 10° 15′ E. and 2° 15′ E., while the northern and the southern limits are in 9° 10′ N. and 4° 20′ N. respectively. Its

total native population is between 6,500,000 and 7,000,000, and there are over 1,500 Europeans in the Colony.

Formerly this area was divided politically into the Colony of Lagos and the Protectorate of Southern Nigeria, each with its own administration, but recently the two have been amalgamated into the " Colony and Protectorate of Southern Nigeria " as a single dependency.

Roughly speaking the old Colony of Lagos is now known as the Western Province, and the old Protectorate is subdivided into two Provinces, the Central and the Eastern (*see* Map). The term " Colony " will be used to denote the whole area, and the subdivisions will be referred to as the Western, the Central, and the Eastern Provinces respectively.

Lagos, an important and flourishing seaport, is the seat of administration of the Colony and also the headquarters of the Western Province, while Warri and Calabar are respectively the headquarters of the Central and the Eastern Provinces. At these three towns are stationed the Provincial Heads of Departments, and here also are situated the three European Hospitals.

The division of the Colony into three Provinces is to a certain degree arbitrary, but to a great extent these form fairly definite geographical areas. As will be seen later, the Western Province has no large rivers but is traversed by the Lagos Railway, which now unites Lagos with Zungeru, Kano and the Bauchi tin mines in Northern Nigeria ; the Central Province is traversed by the River Niger, the main outlet to the sea for exports from both Northern and Southern Nigeria ; and the Eastern Province is drained by the Cross River, which, during the rainy season, is navigable throughout its entire course in Southern Nigeria and even into the German Colony of Kamerun.

Lagos is by far the most important town on the coast, and now that Northern Nigeria has been linked up by means of the railway, a considerable amount of the passenger and light goods traffic which formerly went by way of the Niger will pass through this port. At the present time, owing to the dangerous nature of the bar, mail-steamers are unable to enter the harbour, and all heavy cargo is trans-shipped at Forcados into smaller " branch boats " and then transferred to Lagos, but harbour works are being rapidly carried out, on the completion of which it is hoped that the mail-boats will load and unload direct at Lagos.

The port-of-call for mail-steamers in the Central Province is Forcados, which is undoubtedly the largest shipping port in West Africa. This port must always be the main outlet for exports from a large part of Northern Nigeria, and at the same time, as the headquarters of the Niger Company, it will continue to be the chief port of shipment for the produce of Southern Nigeria. Such being the case, special attention should be directed to it and special efforts made to ensure that the conditions there are such that there could be no possibility of any insect-borne disease obtaining a hold and spreading, even if introduced.

There are two ports in the Eastern Province, namely, Bonny and Calabar, but the latter is by far the more important, and, as in the case of Lagos and Forcados, they must also be regarded as possible centres for the dissemination of disease.

These ports, however, are only the foci of the trade of the Colony, so that it is necessary to go further afield and consider the routes along which this trade comes, the potentiality of these various regions as regards diseases transmitted by insects, and the distribution of the insects implicated. The major features of the geography of the Colony, so far as they concern the investigation in hand, have been briefly dealt with in the various sections of the report, so that it is unnecessary to enter into any discussion of them at this point.

(*b*) Physical Configuration.

The trade of Southern Nigeria has always been intimately associated with the River Niger and its delta, and consequently, not until very recently have the parts of the country removed from this river been traversed by Europeans. The construction of the Government Railway served to open up the Western Province, and within the last few years large tracts of country, particularly in the north-east, have been gradually brought under European influence. This region is known as the Munchi country and is inhabited by a very truculent and vindictive tribe of that name. Consequently our knowledge of the physical characteristics of Southern Nigeria is very limited, but an exhaustive survey of the whole Colony is rapidly progressing. It might be well, however, to note a few of the leading topographical features in so far as they are likely to influence the distribution of the fauna.

There are three distinct river systems in Southern Nigeria and these roughly correspond with the three Provinces :—the Cross River in the Eastern Province, the Niger in the Central Province, and a number of small rivers, the largest of which is the Ogun, in the Western Province.

There are no mountain ranges of any great height in the Colony, the highest being the watershed between the Niger and Cross Rivers, in what is known as the Sonkwala Country, which has only recently been opened up. This range consists of several peaks rising from an extensive plateau, the height of which has been variously estimated, but which, in all probability, does not exceed 4000–5000 feet. Next in importance are the Oban Hills, which lie to the east of the Cross River and form the watershed between it and the Kwa River. The various peaks in this small range are very imperfectly known, but average about 3000–3500 feet in height. The lofty Kameruns in the German Colony of that name constitute the main catchment area for the Cross River and are the only large mountain range on this part of the coast.

In the Ondo district are the Idanre Hills, which consist of several peaks of about 3,000 feet in height. These form the watershed separating the Niger basin in the Central Province from the system of small rivers in the Western Province. Almost continuous with these are the Efon Hills in the Ilesha District ; they run nearly east and west and send their waters on the northern side to the Niger in Northern Nigeria, and their southern waters to the rivers in the Western Province of Southern Nigeria. Of less importance are the Shaki Hills in the north-west and the Tapa Hills between the rivers Awon and Afiki, both tributaries of the Ogun.

As has been shown, the only rivers of any size in the Colony are the Niger and Cross Rivers, but neither of these is dependent on the rainfall of Southern Nigeria to any great extent. The rise of the Cross River is due almost entirely to the heavy rainfall in the German Kamerun hinterland, while that of the Niger is associated with the increased supply from its higher reaches in French Guinea and Northern Nigeria and also from the Benue River. The Benue in turn receives its supply from the Kamerun hinterland. The heavy rainfall of Southern Nigeria is confined practically to the Coast, or delta region, and is consequently almost coterminous with the area of tidal influence.

Generally speaking, the whole of the shore area is low-lying and fringed with mangrove swamp. It consists of a large alluvial plain which extends for hundreds of miles, except on the extreme east, where the Oban Hills almost touch the foreshore and extend northwards to the Kameruns. This alluvial low-lying land reaches its greatest dimensions in the delta of the Niger, which projects so far into the Gulf of Guinea as to form two distinct bays known as the Bights of Benin and Biafra.

Beyond this zone the land gradually rises, and the mangrove gives way to the open grassy plains of the hinterland, which extend to Northern Nigeria. Superimposed on these are the various small mountain ranges already mentioned, which separate the different drainage systems.

The soil is mainly red clay, but the hills are intrusions of metamorphic rocks, granitoid, schistose or quartzite. Here and there beds of limestone occur, and, more commonly, large outcrops of laterite.

(*c*) Vegetation.

As has been shown in my previous reports, the nature of the vegetation in any part of a colony has a distinct bearing on the insect fauna. For this reason it might be well to discuss briefly the main types found in Southern Nigeria, their general character, and their distribution. I am indebted to an admirable paper* by Mr. H. N. Thomson, Conservator of Forests in Southern Nigeria, for a considerable part of what follows in this chapter. The quotations given are taken from that report.

The type of forest found in any particular region depends almost entirely on the rainfall, but occasionally in the drier regions one comes across patches of a type generally associated with a heavy rainfall ; these occur as outcrops due to permanent and abundant telluric moisture.

The forest growths of Southern Nigeria may be divided roughly into :— (*a*) tropical rain forest, (*b*) fresh-water swamp forest, (*c*) monsoon or mixed deciduous forest, (*d*) savannah forest and (*e*) mangrove forest.

Generally speaking, where there is an abundant supply of moisture and little or no differentiation into wet and dry seasons, the tropical rain forest predominates ; where the soil is permanently moist, even if there is a moderately long dry

* Journ. Afr. Soc. X, p. 125.

season, fresh-water swamp forest is to be found; where the soil is more porous, and where there are distinct wet and dry seasons, monsoon forest is in evidence; where the dry season is of still longer duration, the water supply very limited and precarious, and the soil is of a light character, the savannah type is prevalent; while in the river deltas and lagoon, where the tidal influence is felt and the water is brackish, mangrove thicket is everywhere to be found. The distribution of these types in Southern Nigeria can be indicated only in a very general way.

Rain forest may be said to occupy all the areas with an annual rainfall of about 76 inches and upwards, but exists in its most typical form in those regions where there is a rainfall of 100 inches and over, and where the dry season is of extremely short duration or almost entirely absent. These conditions are satisfied to a greater or less extent around Ilesha, Ondo and Ijebu-Ode in the Western Province, in the west and south-west portions of the Benin District in the Central Province, and on the slopes of the Oban Hills and other high ranges in the Eastern Province.

"It is generally assumed that the moist portions of Southern Nigeria are very densely wooded and that the bulk of the land is covered with high rain forest. This, however, is far from being in accordance with the truth, and the mistake has in most cases arisen from the fact that the main native paths and roads are fringed on both sides with broad belts of high forest purposely left intact by the inhabitants . . . The country is literally honeycombed with farms and their overgrown abandoned sites."

Scattered throughout the Colony are many swampy areas and rocky hillsides impracticable for farming, and these have consequently been left intact and bear dense high forests. With the exception of these areas the greater part of the country, lying within the zone of rainfall mentioned, is covered with a secondary growth of a much drier character and considerably less dense than the untouched virgin rain forest.

Fresh water swamp forests are composed of plants that have become adapted to growth in permanently wet soil. They correspond to the kurimis of Northern Nigeria, which I have already described at some length.* No general idea of the distribution of this type can be given beyond pointing out that they occur chiefly along the banks of rivers and streams or are scattered irregularly amongst other formations in places where there is permanent telluric moisture.

The monsoon or mixed deciduous forests contain, as the name indicates, many trees which become leafless in the dry season. They are less lofty than the rain forests and not so dense. Lianes and herbaceous epiphytes are abundant, and the contrast in appearance during the wet and dry seasons is very marked.

"As regards the distribution of the monsoon forests they are confined to those tracts of country where the available water supply and the duration of the dry season operate jointly in such a manner as, on the one hand, to exclude the

* Bull. Ent. Res. II, pt. 4, p. 307.

tropical rain forest and, on the other, so far to favour tree-growth that a woodland formation can still successfully compete against grass forms such as savannah forests. Such conditions are realised in Southern Nigeria along an irregular, tortuous, comparatively narrow belt that lies, roughly speaking, between the 7th and 8th parallels in the Western Province, and between the 6th and 7th in the Central and Eastern Province. This belt is pushed far up north in the extreme north-east portion of the Western Province where numerous hill ranges carry a copious rainfall well into the comparatively dry interior."

Savannah forest is variously described as "park-like" or "orchard-like," and consists chiefly of tall grasses with numerous terrestrial herbs and a few deciduous trees, which are, on an average, less tall than in the mixed deciduous forest. The number of trees varies in different places according to the nature of the soil and the general situation, *e.g.*, on laterite outcrops they are few in number and stunted, while in valleys they are more numerous and healthy. These areas are generally devastated by huge forest fires towards the end of the dry season, and this tends to reduce them from the savannah-forest type to the pure savannah, where trees are practically absent, and where grass tends more and more to predominate over the terrestrial shrubs.

Mangrove thickets are everywhere to be found along the coast, in the various lagoons and backwaters, and in the innumerable creeks and rivers in the delta of the Niger. This type of growth is associated with brackish water and muddy swamp, and is exclusive in character, permitting no intrusion of other trees.

These are the main types of vegetation in Southern Nigeria, and without entering into details at present, that being reserved for fuller discussion under the various regions, it might be well to point out in a general way how these different types are associated with the distribution of the various species of *Glossina*.

G. palpalis is to be found everywhere in the mangrove thicket area, and it is especially noteworthy that in such regions the specimens are larger and darker in colour than in other situations. This species is also the predominant one in the rain forest and in the fresh-water swamp forest.

G. caliginea seems to be confined almost entirely to the mangrove belt.

G. longipalpis is the species most abundant in the mixed deciduous forest region, while in the savannah forest *G. tachinoides* is most likely to be found. As to the other species found in Southern Nigeria, the data available do not justify any definite conclusions being drawn, but the records given throughout the narrative will serve to show how far these species are associated with the different types of vegetation.

II. Climate and Rainfall.

As is well known, climate and rainfall have a marked bearing on the distribution of the various species of blood-sucking insects, and further, certain species show distinct local modifications which are associated with the comparative lengths of the wet and dry seasons, the range of temperature, and the degree of

humidity. There can be no doubt also that temperature and humidity influence the period of reproduction, and may also modify the length of time occupied in the larval stages.

After a consideration of the general physical configuration of the Colony and its vegetation, it may be well, therefore, to discuss briefly the main characteristics of the climate in so far as these affect the problem in hand. Hitherto, no attempt has been made either to consider the climate of the Colony as a whole or to compare the variations in the different regions. Meteorological observations are now made at a large number of stations in Southern Nigeria, so that it is possible, within limits, to form some general opinion of each of these aspects. The figures on which the following notes are based are compiled from the raw data supplied to the Meteorological Office, but for the arrangement the writer is entirely responsible. It has been considered advisable to prepare and include certain tables in order to avoid lengthy descriptions, and also to present the matter in more concrete form.

The climate of Southern Nigeria is, broadly speaking, of the equatorial type. By this is meant that there are two fairly distinct seasons, known as the "dry" and the "wet" or "rainy" season; the latter is often briefly designated as the "rains." The dry season lasts from about the end of October to the beginning of March, but the rainy season, though, properly speaking, occupying the remaining eight months, is again subdivided into the "heavy" and the "light" rains, each with its own maximum. The heavy rains fall during the months of April, May, June and July, while the light rains occupy the other three months.

A similar state of affairs holds good in the case of the temperature curves, which also have two maxima, the first between the middle of March and the middle of April, and another of a secondary order between the middle of September and the middle of October.

During the heavy rains the weather is for the most part dull, with occasional sunshine, and the humidity is great. Throughout the dry season the weather is clear and fine, but there are occasional showers.

The general direction of the wind is from the south or south-west. The wind is consequently full of moisture, but from the end of November to the beginning of March the influence of the Harmattan—a dry wind blowing from the Sahara in the north-east—is very marked. During this period the air is excessively dry and laden with fine particles of dust; the temperature in the morning and evening is very low, and a misty haze hangs about nearly the whole day. The sun is seldom visible before eight in the morning or after five in the evening, and this haze extends far out to sea. Immediately before and after the rainy season, tornados of terrific force, uprooting large trees and often doing considerable damage, blow in the evenings; these are accompanied by torrential rains.

On the whole, the temperature in the shade is not very high, the average maximum temperature being about 91° Fahr., the average minimum about 65°, the mean about 78°, with a daily range of about 26°. The maximum temperature recorded by the thermometer exposed to the full effect of the sun is about 146°

on the average, whilst the "grass" temperature, that is, the minimum with the thermometer at the ground level, is about 46°.

These are the main characteristics of the climate of Southern Nigeria, but there are enormous differences in the various regions; and as it is with these differences that we are more intimately concerned, it may be well to consider briefly the range of these variations from a geographical aspect.

The following tables have been prepared to illustrate graphically the main features, so that I shall content myself by drawing attention only to the more important characteristics :—

Table A.—Annual rainfall at thirteen stations for the years 1905–1910.

„ B.—Monthly record of rainfall at twenty-two stations for 1909 and 1910.

„ C.—Analysis of the rainfall for 1910, showing on how many days in each month at each station rain actually fell, and also the maximum for any one day in each month at the individual stations.

„ D.—Mean monthly humidity at the various stations in 1910.

„ E.—Analysis of the monthly temperatures for the same stations during 1910.

Table A.

Annual Rainfall in Southern Nigeria (in inches).

—	Calabar.	Bonny.	Forcados.	Sapele.	Afikpo.	Bende.	Epe.	Lagos.	Omitsha.	Badagri.	Ibadan.	Oshogbo.	Oyo.
1905	167·39	167·75	—	116·25	83·88	74·67	—	65·11	60·07	—	47·52	40·01	38·61
1906	156·64	142·26	98·33	106·69	93·77	87·08	60·23	74·76	—	58·34	46·40	47·95	46·60
1907	129·68	143·51	—	62·33	70·38	74·18	55·82	79·46	48·46	75·22	38·26	—	43·81
1908	132·78	160·36	145·28	118·52	85·56	—	76·93	69·98	69·88	70·02	49·48	51·43	—
1909	150·24	110·78	149·25	107·72	—	—	85·28	67·59	91·36	58·87	62·26	63·04	—
1910	—	—	114·30	105·24	—	—	82·09	69·43	69·62	53·06	60·00	—	—
Total	736·73	724·66	507·16	616·75	333·59	235·93	360·35	426·33	339·39	315·51	303·92	202·43	129·02
Mean	147·34	144·93	126·79	102·79	83·39	78·64	72·07	71·05	67·87	63·10	50·65	50·60	43·00

In this table (A) I have selected thirteen stations in which the records for the years 1905–1910 are fairly complete and which are, at the same time, representative of the various parts of the Colony. The mean for these years has been taken as an index of the rainfall of the several stations, which have been arranged in order of descending maxima. The most striking fact revealed by an examination of this table is the enormous range in the mean annual rainfall, for example, 147·34 inches at Calabar, and 43·00 inches at Oyo, while the maximum

recorded since 1905 for any one year was at Calabar in that year, namely, 167·39 inches; at Shaki in the extreme north-west only 17·85 inches fell in 1908.

As has already been pointed out, the coast-line of Southern Nigeria is very irregular in shape, so that it is not possible in all cases to compare places in the same latitude, but, generally speaking, stations on the same parallel of latitude have similar rainfalls; the table also serves to show that the rainfall diminishes from the coast northwards, but not so markedly along the basins of the Niger and Cross Rivers; for example, Lagos 71·08 inches, Ibadan 50·65 inches, Oyo 43·00 inches, and at Shaki the mean for the two years (1907–8) during which observations were recorded, 25·33 inches; or again Calabar 147·34 inches and Afikpo 83·39 inches. Further examination, however, reveals the fact that these means, though very diverse in magnitude, may be grouped according to definite geographical areas thus :—

(1) *Calabar*. The mean annual rainfall at this station, nearly 150 inches, is the highest for the Colony. This station is situated on the Coast in what might be termed the Cross River Delta, and further it is at the base of the Kamerun Mountains.

(2) *Bonny*, *Forcados* and *Sapele*. These three stations have a mean annual rainfall of over 100 inches and may be topographically considered as lying within the Niger delta. In this region it will be seen that the rainfall decreases from the coast inland.

(3) *Afikpo* and *Bende*. The mean annual rainfall in this area is about 80 inches. Both these stations are in the Cross River system, but Afikpo, though further north, has a slightly higher maximum owing to its closer proximity to the basin of the river.

(4) *Epe*, *Lagos*, *Badagri* and *Onitsha*. Lagos, Epe and Badagri are all situated along the coast in the Lagoon region, but Onitsha is on the Niger about 150 miles north of Forcados. Owing, however, to its being actually in the basin of the Niger, its rainfall is greater than its inland situation would otherwise lead one to expect.

(5) *Ibadan*, *Oshogbo* and *Oyo*. These three stations may be grouped together as representative of the hinterland of the Western Province, while a still further reduction in the mean rainfall is seen in the case of Shaki, where in 1908 only 17·85 inches were recorded. Unfortunately, this region is comparatively unknown, and, as no European is now stationed there, no further meteorological observations are available.

Generally speaking, therefore, the greatest rainfall is in the Eastern Province, near the Kamerun Mountains; it is slightly less in the delta of the Niger, while along the Lagoon region and in the basins of the Niger and Cross Rivers there is a still further decrease. The area with the least rainfall is the hinterland of the Western Province. These facts are of some importance in a study of the distribution of the various species of blood-sucking insects.

Table B.

Monthly Record of Rainfall in Inches for 1909 *and* 1910.

1909.

Station.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Brass ...	·40	4·81	14·10	14·89	12·44	37·16	30·05	10·22	17·35	14·78	4·71	5·06	165·97
Calabar ...	·17	5·78	9·26	7·58	9·36	17·72	33·01	26·35	28·82	5·85	5·40	·94	150·24
Forcados...	1·55	2·45	9·45	13·50	16·10	29·20	20·50	14·50	20·60	11·80	7·00	2·60	149·25
Akassa ...	2·61	4·68	2·28	12·34	8·51	30·28	24·02	5·55	16·56	19·09	7·89	4·27	138·08
Bonny ...	2·50	8·67	9·84	7·30	6·32	22·14	34·68	6·09	8·08	1·91	2·67	·58	110·78
Sapele ...	1·60	3·63	7·00	16·66	15·17	14·67	18·18	13·40	9·83	4·48	2·86	·24	107·72
Warri ...	2·11	6·61	1·81	8·42	11·16	17·40	14·15	9·39	17·19	11·45	3·87	·43	103·99
Owerri ...	·75	·99	5·07	8·06	7·92	11·56	17·03	12·84	16·23	14·13	·80	2·11	97·49
Opobo ...	1·05	4·00	2·76	3·37	8·17	17·43	19·76	6·89	18·64	2·33	5·23	2·30	91·93
Onitsha ...	·61	1·13	6·81	6·24	6·23	8·10	21·33	11·43	14·40	7·08	·92	7·08	91·36
Degema ...	·35	4·41	7·35	4·37	8·36	11·95	25·44	8·32	6·22	7·46	2·55	1·70	88·48
Epe ...	nil	7·22	1·20	4·76	8·53	17·98	17·97	8·62	4·08	10·69	3·55	·68	85·28
Abo ...	·08	2·44	8·22	6·11	6·20	10·51	15·62	9·75	11·29	11·55	3·31	·19	85·27
Benin City	2·56	1·86	1·98	7·98	8·09	12·58	15·88	14·20	4·23	9·42	1·85	·35	80·98
Olokemeji	1·03	3·16	7·71	8·97	6·40	10·30	12·36	4·69	6·09	6·76	1·42	1·54	70·43
Ondo ...	1·02	4·05	2·47	11·57	4·72	5·26	15·26	5·94	5·24	13·45	—	—	68·98
Lagos ...	4·75	5·27	3·36	5·52	7·08	19·55	5·63	1·40	5·31	5·80	2·50	1·42	67·59
Oshogbo ...	·90	3·39	2·82	6·84	3·69	8·44	11·76	6·60	8·14	8·37	1·20	·89	63·04
Ibadan ...	·30	5·23	6·30	8·42	4·82	9·60	10·02	6·24	4·65	3·98	·52	2·18	62·26
Badagri ...	3·92	1·03	3·25	11·93	7·14	11·20	7·62	1·36	2·88	5·62	1·15	1·77	58·87
Abeokuta	nil	6·50	3·67	9·51	5·29	10·33	6·33	3·67	3·82	4·98	1·22	1·94	57·26
Otta ...	·99	1·76	3·05	5·32	4·47	7·60	4·05	1·12	3·00	3·28	3·78	1·67	40·09

1910.

Station.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Brass ...	·91	4·57	7·84	6·01	7·64	21·88	19·94	11·61	25·19	19·32	12·52	4·91	142·34
Calabar ...	·03	1·59	·89	3·52	5·87	6·89	10·58	41·24	20 77	10·73	—	·39	102·50
Forcados...	·05	3·50	2·85	7·15	17·70	14·60	19·30	15·75	21·89	10·80	·80	·30	114·39
Akassa ...	1·30	5·29	8·31	8·75	11·74	27·08	21·18	8·40	25·32	17·23	6·77	7·55	148·92
Bonny ...	1·50	4·00	—	9·40	7·06	29·24	17·80	19·65	16·35	13·25	11·52	2·28	132·05
Sapele ...	nil	·10	3·54	10·29	6·90	18·84	16·64	21 09	16 42	11·42	nil	nil	105·24
Warri ...	1·57	·29	2·47	8·25	8·00	24·74	9·15	19·17	19·49	9·65	4·50	·35	107·63
Owerri ...	·68	2·91	1·56	8·89	6·27	14 60	8·26	21·85	15·07	6·02	nil	—	86·01
Opobo ...	·71	4·65	2·85	5·56	4·82	10·88	18·37	23·24	19·33	14·08	5·42	nil	109·91
Onitsha ...	·43	1·82	2·06	5·34	5·26	5·54	12·09	17·67	8·87	10·34	nil	·40	69·82
Degema ...	·85	·65	4·57	9·73	9·69	8·91	11·61	10·98	13·57	4·28	3·30	nil	78·14
Epe ...	·57	·95	·54	6·46	10·39	14·50	22·41	9·98	7·48	7·95	·37	·49	82·09
Abo ...	·66	·53	3·35	3·42	17·30	11·84	15·90	8·98	7·99	3·96	nil	nil	73·93
Benin City	nil	·89	·71	1·51	10·24	12·44	10·94	15·75	18·08	8·96	1·50	nil	81·02
Olokemeji	nil	nil	3·87	6·19	6·49	9·56	5·83	6·48	6·41	7·02	·94	nil	52·79
Ondo ...	—	·12	1·45	4·35	4·37	8·44	13·67	14·14	11·03	6·28	nil	—	63·85
Lagos ...	·38	·08	·94	4·48	8·79	16·70	21·39	2·82	4·95	7·00	1·86	·14	69·53
Oshogbo ...	·01	·98	3·36	4·80	7·03	4·29	8·72	—	7·47	4·29	·48	nil	41·43
Ibadan ...	·23	·53	2·71	10·44	6·25	9·18	9·91	5·94	4·37	10·44	nil	nil	60·01
Badagri ...	nil	nil	1·77	3·57	6·07	11·99	17·17	·80	4·63	5·96	1·10	nil	53·06
Abeokuta	nil	1·28	2·99	7·71	4·62	5·21	11·03	3·45	6·35	—	—	—	42·64
Otta ...	nil	·55	2·11	4·35	10·25	6·90	8·88	3·40	5·55	6·45	nil	nil	48·44

In Table B are given the monthly records of the rainfall for 22 stations throughout the Colony for the years 1909 and 1910. These have been arranged in order of descending totals for the year 1909, and while it will be noticed that for this particular year the order is not precisely the same as in the table of the mean annual rainfall for the six years, still the grouping is not materially affected. A comparison of the tables for 1909 and 1910 also shows that there are certain discrepancies, and that although there is, in general, a diminution from the south northwards, certain stations, for example, Ondo and Olokemeji, do not fall within this category. The reason for this is not at first very evident, but an examination of the tables will show that in the drier regions where there are large hills or dense forest, the rainfall is always greater ; this explains away the apparent anomaly of Ondo, Olokemeji, and stations in the vicinity of the Kameruns.

Let us now consider for a moment the duration of the dry season in the various regions, and for this purpose we may neglect a rainfall of below 1·5 inches in any one month. In 1909, at no station were there two months without any rain, while, even disregarding 1·5 inches, never did the number of dry months exceed three. The driest months were December and January ; February came next with a low rainfall, and only slightly higher was November. In 1910, however, November, December, January and February might be regarded as comparatively dry months, but it will be seen that in the delta region at Akassa and Brass even in February there was a rainfall of 5·49 inches and 4·57 inches respectively, while in November the rainfall at Brass, Bonny, and Akassa was 12·52, 11·52 and 6·77 inches respectively.

Generally speaking, the dry season lasts from November to February and tends to increase in length from the south northwards. This will be most easily seen by comparing Calabar, Bonny, Brass and Akassa with Olokemeji, Oshogbo, Otta and Ibadan, but even then one must always bear in mind that in different years rain may fall during all four months. Consequently, it is hardly justifiable to speak of a true dry season in Southern Nigeria. In the inland parts there is an approach to a dry season, and this period gradually increases in Northern Nigeria, until in the northern regions of that Protectorate there is a definite division of the year into a wet and a dry season.

The records of blood-sucking insects from both Northern and Southern Nigeria are perhaps too scanty to admit of any definite deductions being drawn, but in another part of this paper, when discussing the genus *Glossina*, I hope to show that the distribution of the various species in these two colonies is closely correlated with the rainfall and relative humidity.

A consideration of the monthly rainfall at Ondo and Olokemeji will show how the apparent discrepancy in the total rainfall for the year is brought about. Although the annual total is greater in this region than one would be led to expect, it will be seen that this is due, not to a rainfall extending over a greater number of months, but to a greater monthly intensity during the rainy season.

A comparison of the monthly records for the various stations in Table B will also show what is meant by two annual maxima. It will be evident that, as a general rule, although it varies in different years and at various stations in the same year, the rainfall increases gradually from January to about the end of

June or early in July, after which it abates somewhat, and the curve falls considerably during July and early August, when the rain again increases in intensity until September or October is reached, again diminishing in amount till January. The maximum in June to July is much greater than that in September to October, while the minimum in August does not fall so low as in December to January. Thus, in the southern belt, rain falls during nearly every month in the year, but there are two well marked maxima and minima in the rainfall curves. This is known as the equatorial type. These maxima tend to fuse in the northern part, especially in the Western Province, to form one annual maximum ; the number of months with a small rainfall increases, and there are some without any. This can be seen most readily by plotting out graphs for the various stations.

Table C.

Analysis of Rainfall for 1910.

Station.	—	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Brass ...	Max.	·58	1·77	2·24	1·26	2·18	3·50	7·45	2·61	5·43	3·32	3·75	2·80
	Days	2	9	10	13	12	20	14	22	25	20	17	9
Calabar ...	Max.	—	·83	·58	·65	1·65	·80	2·10	4·05	3·40	2·20	—	·29
	Days	—	6	4	15	14	18	21	31	21	18	—	2
Forcados...	Max.	·05	1·60	1·10	1·80	3·10	1·60	3·10	3·10	5·10	2·30	·50	·30
	Days	1	4	6	11	20	19	21	20	18	17	2	1
Akassa ...	Max.	·56	2·20	2·68	1·47	2·45	7·74	5·33	1·96	4·05	3·15	1·03	2·15
	Days	6	11	11	16	13	19	16	20	22	23	15	7
Bonny ...	Max.	1·00	1·50	—	2·33	2·38	7·50	3·00	3·35	3·10	2·50	3·10	1·44
	Days	2	5	—	15	15	15	11	14	9	9	10	8
Sapele ...	Max.	—	·10	1·50	2·10	·88	4·20	3·72	3·50	2·70	3·66	nil	nil
	Days	—	1	7	9	13	14	13	16	15	10	nil	nil
Warri ...	Max.	1·57	—	1·19	2·32	2·05	7·40	2·05	6·11	4·00	2·40	·96	·24
	Days	1	—	4	7	10	14	9	20	15	9	7	3
Owerri ...	Max.	·41	1·95	1·52	3·05	1·08	2·33	2·05	3·10	2·11	1·45	nil	—
	Days	2	3	2	11	16	21	14	24	22	12	nil	—
Opobo ...	Max.	·33	—	1·07	1·50	1·55	4·15	4·52	2·47	4·05	2·92	1·20	nil
	Days	3	—	4	10	8	15	12	21	14	16	9	nil
Onitsha ...	Max.	·35	1·05	1·05	2·05	·85	1·56	3·40	2·83	2·27	2·20	nil	·40
	Days	2	4	3	7	11	9	17	19	14	13	nil	1
Degema ...	Max.	·55	·31	1·90	1·70	2·10	2·12	3·56	1·48	2·62	1·95	1·76	nil
	Days	2	3	5	9	16	11	14	24	11	8	4	nil
Epe ...	Max.	·57	·60	·24	1·97	1·76	2·55	8·25	1·88	1·80	1·64	·14	—
	Days	1	2	3	8	11	11	18	11	12	11	3	—
Abo ...	Max.	·41	·44	1·12	1·27	4·34	3·02	8·20	·98	·83	·67	nil	nil
	Days	2	3	4	10	13	19	22	26	23	13	nil	nil
Benin City	Max.	—	·86	·67	·46	1·64	4·15	1·75	3·73	2·43	1·48	·80	nil
	Days	—	2	2	6	12	13	21	23	19	17	3	nil
Olokemeji	Max.	nil	nil	2·04	2·67	1·70	2·89	·31	1·42	1·52	1·43	·94	nil
	Days	nil	nil	6	11	11	17	19	23	21	19	1	nil
Ondo ...	Max.	—	·12	·80	·85	1·53	1·52	1·51	7·04	2·50	·92	nil	—
	Days	—	1	4	8	4	15	5	18	15	16	nil	—
Lagos ...	Max.	·38	·07	·73	1·31	1·43	5·00	4·10	·92	2·45	2·06	1·11	·11
	Days	1	2	2	8	15	22	17	17	13	12	3	2
Oshogbo ...	Max.	·01	·95	1·34	1·12	1·12	·91	2·31	—	1·81	·91	·47	nil
	Days	1	3	4	10	13	18	14	—	13	18	2	nil
Ibadan ...	Max.	·23	·36	1·25	3·20	1·91	2·42	3·45	1·60	1·13	2·05	nil	—
	Days	1	2	8	11	8	10	15	11	8	11	nil	—
Badagri ...	Max.	nil	—	—	1·30	1·24	—	3·95	·30	2·05	2·70	·70	nil
	Days	nil	—	—	6	11	—	9	5	3	5	3	nil

Table C has been prepared to demonstrate more clearly the nature and extent of the dry and the wet seasons at the various stations in the Colony. The first line for each station gives the maximum rainfall for any one day in each month, while the second shows the number of days on which rain fell at the respective stations in each month. An examination of the data reveals several important facts :—(1) the enormous daily rainfall during the wet season in the Niger delta, *e.g.*, 7·45 inches in one day in July at Brass, 7·74 inches in one day in June at Akassa, 7·40 inches at Warri in June, and 8·25 inches at Epe in July within the same time ; whereas in the northern districts, *e.g.*, at Olokemeji, 2·67 inches in April and 2·89 inches in June were the highest daily rainfalls recorded in 1910. (2) It also shows how the rainfall given in Table B was distributed throughout the various months. (3) A comparison of the number of days on which rain fell in the different months will also emphasise the nature of the compound curve of rainfall and the relative positions of its maxima. This would, however, have been more evident had it been possible to give the records in half-monthly frequency.

TABLE D.

Mean Monthly Humidity for 1910.

Station.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean.
Brass ...	93	78	78	78	74	77	81	84	75	85	80	80	80·2
Calabar ...	92	89	82	92	93	92	89	—	90	72	—	90	88·1
Forcados ...	86	83	74	85	87	93	88	—	95	80	80	80	84·6
Akassa ...	73	90	76	75	76	73	80	80	80	85	85	80	79·4
Bonny ...	89	93	—	100	91	92	88	87	85	89	90	95	90·8
Sapele ...	88	86	79	71	90	65?	90	91	59	85	90	94	82·3
Warri ...	88	—	88	90	64	71	92	—	94	85	85	94	85·1
Owerri ...	87	73	66	76	75	83	82	90	75	80	80	—	78·8
Opobo ...	91	—	81	78	33?	89	87	78	80	95	95	95	82·0
Onitsha ...	84	83	80	90	90	87	89	—	89	89	85	89	86·8
Degema ...	87	86	90	87	83	91	87	97	85	85	85	85	87·3
Epe ...	83	91	84	81	81	87	93	—	—	79	85	85	84·9
Abo ...	83	86	76	85	83	82	81	84	80	76	80	85	81·7
Benin City	96	95	99	96	94	95	95	—	94	94	94	89	94·6
Olokemeji	75	81	73	84	83	86	87	82	89	94	85	95	84·5
Ondo ...	—	74	84	59?	—	84	—	71	84	84	78	—	77·2
Lagos ...	63	71	68	73	74	77	80	82	77	77	73	74	74·0
Oshogbo ...	62	83	68	—	—	—	—	—	—	—	—	—	71·0
Ibadan ...	75	93	86	80	92	89	91	92	94	79	89	—	87·2
Badagri ...	79	81	—	81	74	—	78	—	75	80	80	72	77·7
Abeokuta ...	85	90	—	—	—	94	99	—	—	—	95	—	92·6
Otta ...	—	—	—	—	—	98	87	89	79	—	85	85	87·1

Table D gives the mean humidity for each month in 1910 at the same twenty-two stations. A comparison of this table with that given for Northern Nigeria* will show how much greater is the general humidity near the coast than in the upland districts, for the annual means are about on a level with the average annual maxima in Northern Nigeria. It is unnecessary to discuss the details, but a glance will be sufficient to show that in the delta region there is very little difference in humidity throughout the various months of the year, while in the

* Bull. Ent. Res. II, pt. 4, p. 312.

north, where the dry season is of longer duration, although the humidity may reach a very high percentage in the wet season, it does not maintain its intensity during the months when there is little rainfall.

Table E.

Monthly Temperatures for 1909.

Station.		Jan.	Feb.	Mar.	Apl.	May.	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean.
Olokemeji ...	Max. ...	98	97	95	96	96	90	88	89	89	92	94	95	93·2
	Min. ...	54	69	68	68	68	63	68	68	67	67	69	58	65·6
	Av. Max.	92	87·8	88·1	90·4	90	86·5	84·2	83·7	83·9	89	91·8	91·0	88·2
	Av. Min.	69·4	73·5	73	73·1	72·6	72·3	72	71·3	70·6	71·6	73·6	69·9	71·9
Onitsha ...	Max. ...	94	94	96	97	96	94	88	89	91	91	94	92	93
	Min. ...	63	70	69	69	68	68	67	69	69	69	69	69	68·2
	Av. Max.	89·2	90·1	91·3	92	90·4	87·3	83·6	83·7	85·6	86·4	89·9	86·6	88
	Av. Min.	72	74·4	74·3	73·3	73·2	72·1	71·4	71·7	72·5	74	74	74	73
Ibadan ...	Max. ...	95	96	94	97	93	90	88	87	88	95	96	96	92·9
	Min. ...	55	61	61	59	61	59	60	60	58	59	61	59	59·4
	Av. Max.	90·9	92·3	91·1	90·7	89·8	85·8	82·6	82·2	84·5	88	84·8	91·5	87·8
	Av. Min.	64·7	69	65·8	64·3	64	63·3	62·5	61·4	61	62·2	65·1	64·3	63·8
Sapele ...	Max. ...	90	95	92	94	93	95	93	90	96	95	92	89	92·8
	Min. ...	60	70	70	69	70	70	60	60	69	67	71	69	67
	Av. Max.	86·5	89	88·3	88·9	89	85·7	83·8	83·6	84·4	87·5	88·2	86·2	86·7
	Av. Min.	70·6	73·3	74·6	73.4	73·1	72·3	67·7	63·3	70·5	72	72·4	71·9	71·2
Owerri ...	Max. ...	92	93	94	96	95	92	87	87	88	91	92	92	91·6
	Min. ...	60	65	64	65	65	64	65	65	61	63	65	63	63·7
	Av. Max.	89·2	91	90	88	92·5	88·6	84·5	84	84·7	87	88·8	88·7	88·1
	Av. Min.	66	69	69·3	67·8	67·9	66·8	66·9	67·1	66·1	66·4	69·6	67·4	67·5
Forcados ...	Max. ...	99	89	90	90	92	89	90	89	90	90	90	94	91
	Min. ...	59	64	62	60	60	59	59	59	59	65	60	64	60·8
	Av. Max.	89	84·1	86·8	87·1	86·8	84·7	85·1	85	86·8	87	86·9	88·4	86·4
	Av. Min.	66·6	68	70·3	66·2	65·2	64·7	65·2	66	65·5	66·7	65·9	66	66·3
Calabar ...	Max. ...	95	92	92	93	93	91	89	88	80	90	90	91	91
	Min. ...	64	70	70	70	70	69	70	71	70	71	71	70	69·6
	Av. Max.	89	88	89·6	89·8	90	87·7	86·4	86	86·1	88·9	89·1	89·4	88·3
	Av. Min.	73	72	71·5	70·5	70·6	70	70·4	71	70·3	71	71·2	70·7	71
Oshogbo ...	Max. ...	94	95	96	95	92	92	84	83	91	87	88	89	90·5
	Min. ...	58	60	64	68	67	65	64	64	68	65	65	64	64·3
	Av. Max.	91·6	91·4	92·4	91·2	88	87·9	79	79·1	88	84·3	86·2	86·4	87·1
	Av. Min.	62·4	64	68·5	70·9	69·7	67·7	66·2	66·2	69·8	69	71·5	70·3	68
Brass ...	Max. ...	92	92	92	92	92	90	88	88	88	90	91	90	90·4
	Min. ...	52	59	60	63	71	70	71	71	68	68	70	67	65·7
	Av. Max.	86	89·7	89·5	85·5	88·7	84·8	82·6	85·5	84·9	86·3	87·3	87·6	86·5
	Av. Min.	62·6	64	64·2	69·8	74·7	73·2	73·4	74	73·7	72·8	74	73·1	70·8
Bonny ...	Max. ...	89	90	92	99	96	90	78	85	89	91	89	90	89·8
	Min. ...	66	68	66	60	71	66	68	70	67	68	68	71	67·4
	Av. Max.	86·4	86·8	89·2	89·2	88·2	82	80·2	83·9	82·0	84·8	86	88·5	85·6
	Av. Min.	72·8	73·8	72·2	73·2	4	72·8	71·3	72·1	71·1	70·7	71·1	72·4	72·3
Lagos ...	Max. ...	91	90	93	91	90	89	85·2	88	87	89	91	90	89·5
	Min. ...	68	71	73	72	73	70	71	71	70	71	72	71	71
	Av. Max.	86·8	87·4	89·9	87·8	87·9	87·4	82·7	83·7	84·5	86·3	87·9	87·7	86·5
	Av. Min.	73·8	75·7	77·2	76·4	76	74	74·1	73·8	73·1	74·1	75·6	75	74·9
Degema ...	Max. ...	89	89	90	95	97	85	89	86	85	88	89	89	89·2
	Min. ...	70	72	69	71	69	65	61	69	64	62	68	72	67·6
	Av. Max.	86·1	87	87·1	87·2	85·8	80·8	79	81	80	81·8	83	84·8	83·6
	Av. Min.	71·5	76·2	75·5	75·4	73·6	71·8	70·1	73	72	71·8	74·2	76	73·8
Badagri ...	Max. ...	87	89	88	89	90	86	84	84	84	87	88	88	87
	Min. ...	61	66	67	63	70	71	67	69	70	66	66	67	67
	Av. Max.	85·1	85·4	86·3	85·9	86·3	81·8	81·3	81·1	81·4	84	86·7	86	84·3
	Av. Min.	71·5	73·3	74·6	73·8	76·6	77·5	73·6	71·8	71·7	71·2	73·1	71	73·3

In Table E I have collected the records of monthly temperatures for thirteen stations in the Colony, giving (1) the maximum for one day during each month, (2) the minimum for one day during the month, (3) the average maximum for the month, and (4) the average minimum for the month. The stations have been arranged in descending annual maxima. It is unnecessary to enter into any detailed discussion of the various data here presented, but I should like to draw attention to some of the major features :—

(1) The means of the average monthly maxima all lie within a very circumscribed compass ; at one extreme stands Calabar with a mean of 88·3° F., and at the other Degema with a mean of 83·6° F.

(2) The means of the average monthly minima show a similarly low range ; for example, Lagos with 74·9° and Ibadan with 63·8° are the most diverse.

(3) The difference between the maxima for the various months is comparatively slight. Thus, the greatest divergence was 21° at Bonny (99° in April and 78°* in July), while at Oshogbo the difference was only 13°, and at Brass it was least of all—namely, 4°. The range is least in the delta region, and greatest in the north.

(4) The same is true with regard to the range in the minima.

(5) The difference between the maximum and minimum in any one month is greatest in the dry season, and, generally speaking, more in the north than in the south.

The extremes of shade temperature recorded for S. Nigeria are 46° and 110° ; the highest average of maximum shade temperature is 93·2° at Olokemeji, and the lowest average of minimum 59·40° at Ibadan, both in the Western Province.

The mean height of the barometer at sea-level is about 30 inches, with a total range of 0·10 inches between the highest and lowest readings during the day-time.

It must not be considered that these few observations by any means exhaust the deductions to be drawn from these tables, but they constitute the most important from the point of view of the distribution of the insect fauna, and when these are borne in mind, many points, otherwise obscure, will be found to be correlated with the general climatic conditions.

The whole may be recapitulated thus :—

(1) Stations in the same latitude have similar rainfalls.

(2) The rainfall is greatest successively at Calabar, in the Niger delta, and in the lagoon region along the coast, and diminishes from the south northwards, except along the river basins and in the hilly regions.

(3) Where the rainfall in the north, *e.g.*, at Ondo, is greater than in the surrounding country, it is due to a greater intensity during a few months, and not to an increase in the number of rainy months.

(4) The rainfall curve is of the equatorial type—that is, there are two annual maxima and minima, the maxima tending to fuse into one in the northern parts of the Western Province.

(5) The dry and wet seasons are not very definitely separated, but the rainfall is almost negligible from November to February, and the duration of this dry season increases from south to north.

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* It is not improbable that this record is much too low.

(6) The humidity is greatest in the delta of the Niger and is much greater in Southern than in Northern Nigeria, the monthly range increasing from south to north.

(7) The means of the average monthly maximum temperatures, and also of the minima all lie within a very circumscribed compass.

(8) The range in the maxima for the various months increases from south to north, as also does the difference between the maximum and minimum in any month, this difference being greatest in the dry season.

III. Narrative.

(*a*) *The Western Province.*

This province, which includes the old Colony of Lagos, is situated in the Bight of Benin, and extends from French Dahomey on the west to the Central Province of Southern Nigeria and the Kabba Province of Northern Nigeria on the east, while on the north it is bounded by the provinces of Ilorin and Borgu in Northern Nigeria. It has an area of over 28,000 square miles and a population of over two and a half millions.

Topographically it is distinct from the rest of the Protectorate and also from Northern Nigeria, but is more intimately connected with French Dahomey. With the exception of the lagoons in the south, which connect with the delta of the Niger, it has its own distinctive river system. It is irrigated by several small rivers with innumerable tributaries, practically all of which have their origin within the Province. These pour their waters into the series of lagoons which unite and connect with the sea at Lagos.

The hills of Shaki in the north and those of Ilesha in the north-east form the water-shed between this system and the tributaries of the Niger which flow northwards in this region, while the Idanre hills in the Ondo District constitute a dividing line between the rivers of the Western and Central Provinces.

The largest and most important river in the Province under discussion is the Ogun, which rises practically at the boundary of Northern and Southern Nigeria in the extreme north-west, runs almost due south through the districts of Shaki, Oyo, Ibadan, and Abeokuta, and empties itself into the Lagos lagoon between Ebutemetta and Ikorodu. On this river the most important towns are Olokemeji, Aro, and Abeokuta, all of which are on the Lagos Railway, which follows the valley of the river from Ebutemetta to a point some distance north of Eruwa Road.

The chief tributaries of the Ogun River are the Opeki, the Oyun, the Owiwi, and the Awon, which all rise in the highlands of Shaki, and, running in a south-easterly direction, join the Ogun on its right bank.

West of the Ogun River, the only stream of any importance is the Yewa River, which rises in French Dahomey and enters Nigeria south of Meko. Running almost due south through the district of Badagri, close to the French border, it enters the Badagri lagoon near the town of that name.

East of the Ogun River are a large number of small streams which rise in the north of the Ibadan and Ilesha districts, and flow almost due south to enter the

system of lagoons which lie parallel with the coast-line. The chief of these are the Owuri, which flows into the Lagos lagoon, the Omi into the Ikorodu lagoon, the Oshun, the Shasha, and the Oni, which pour their waters into the Lekki lagoon, and the Oluwa River, which empties itself into the Mahin lagoon. It must be remembered, however, that all these lagoons are united and open to the sea only at one point, namely, near Lagos.

It will thus be seen from the general direction of the flow of these rivers, namely, almost due south, that there is a gradual diminution in the altitude from the north southwards, interrupted by no intrusive ranges of hills of any importance. For this reason, in considering the physical configuration of the Province, it is convenient to divide the country into four zones more or less parallel with the coast.

The first, or outer, zone consists of long peninsulas, islands and sandbanks which separate the ocean from the series of lagoons already mentioned. These lagoons, though all connected, vary considerably in depth and expanse; in some places they widen out into extensive lakes, at others they contract into narrow channels enclosing numerous flat marshy islands or sandbanks. In most parts these waterways are navigable for small launches, and by this means there is a regular marine service between Lagos and Badagri on the west, and on the east between Ikorodu, Epe and Siluko on the boundary between the Western and Central Provinces, some fifty miles from the sea.

Beyond the lagoon area, for some ten miles inland, there is a flat tract of country, in some places sandy and much cultivated, in others consisting of numerous extensive swamps. In the latter area the inhabitants are chiefly fishermen and salt-collectors. During and after the rains many of these swamps become small lakes and connect with the main lagoons by small channels which are often navigable for canoes.

Beyond this second zone the forest country commences, and the land gradually rises until the watershed of the Niger is reached, which is formed by an oblique range of hills between the 8th and 9th parallels, consisting of the Idanre hills, and the highlands of Ilesha, Oshogbo and Shaki. In some parts (for example, the Forest of Ondo), the vegetation is very thick, and there are abundant large high trees, whose foliage serves to produce a very dense shade. In such forests the stillness, broken only by the chirruping of the cicadas, is oppressive; the temperature is several degrees lower than in the open, but the moist clammy air is almost suffocating. In other parts, however, there are numerous large expanses of undulating park-like country, where a certain amount of cultivation is done, but on the whole the population is scanty.

Beyond this forest region, which north of Lagos is about 40 miles wide, the country opens out, and extensive views can be had from the tops of the small hills, *e.g.*, at Abeokuta and Meko, and beyond this the country is, for the most part, open and fertile. The population is very dense in this area, and there are a few towns of very large size, *e.g.*, Ibadan with 200,000 and Oshogbo with 40,000 inhabitants. Towards the boundary of Northern Nigeria there are bare granitic, gneiss and schistose hills; the country is much drier, and the trees are thinly scattered, low and stunted.

Politically, the Western Province is divided into a number of districts, and for the present purpose it might be well to discuss each of these in turn, always having regard to the various hydrographic systems. From west to east are the Rivers Yewa and Ogun, which drain the districts of Badagri, Meko, Abeokuta, part of Ibadan, Oyo and Shaki ; and these, along with Lagos, form an almost complete unit. In the east are the various small rivers already mentioned, draining the districts of Ikorodu, Epe, Ijebbu Ode, Ondo, Ilesha, the remainder of Ibadan and Oshogbo ; and these again form a more or less distinct topographical unit. The Lagos Railway in its lower portion passes through the first-named area, while beyond Ibadan it enters the second, and continues within it until it reaches Northern Nigeria at Offa.

(1) Badagri.

This is one of the most westerly districts in the Province, and is bounded on the west by French Dahomey. The only river of any importance in the district is the Yewa, which is navigable for a short distance for small launches, and to Egoa for moderate-sized canoes. A large amount of produce is brought down this river to the town of Badagri, where a large market is held, and there is considerable intercourse with the natives in French Dahomey. The coastal region is low, flat and swampy, and lies on the Badagri lagoon, which is separated from the ocean by a long narrow peninsula. The town of Badagri is reached by steam-launch along the lagoon from Lagos. Inland from the coast area there is a broad forest belt which extends for a distance of 40–50 miles. Beyond this region the country becomes more open and park-like in character, and there is a succession of small hills and valleys, which extend into the Meko district in the north. The whole trend of the country is towards a slight increase in elevation northwards.

In the sub-district of Idi-Oroko, the chief town of which is Okeodan, the country is low and flat, and during the dry season water is very scarce in this part. Guinea-worm is very prevalent all over the district, but more especially in Idi-Oroko.

The chief industries of the natives are agriculture and fishing ; sheep and goats are plentiful, but very few cattle and no horses are kept.

Elephant and bush-cow are said to occur on the Yewa River, but with the exception of a few small antelope, and these not in any abundance, there is little game in the district. The natives, especially in the north, are great hunters, and as there are a few guns in every village, the absence of game of all sorts is not surprising.

During my visit to this district at the height of the dry season, in February, 1910, the number of blood-sucking flies was at its minimum. At Badagri the only species seen were *Mansonioides uniformis* and *Tabanus par*, while the former species was also obtained at Ere, and *Myzomyia costalis* at Agilete. From the sheep and dogs at several places numerous ticks were obtained :—*Amblyomma variegatum* on dogs at Ere and Agilete, *Haemaphysalis leachi* and *Rhipicephalus sanguineus* from sheep at Ibesha. At the latter place also *Ctenocephalus canis* was found on dogs, and several *Dermatophilus penetrans* were taken from the

carriers' feet. I examined a long stretch of the river at Egoa, but saw no biting flies of any sort. At this town the dogs were simply swarming with *Ctenocephalus canis*.

Capt. L. E. H. Humfrey, who has made extensive collections of insects from Southern Nigeria, was stationed at Badagri for a short time, and from the "Yewa River" he sent the following species of blood-sucking flies :—*Glossina palpalis*, *Glossina caliginea*, *Tabanus fasciatus*, *T. secedens*, *T. socialis*, *T. taeniola*, *T. thoracinus*, *Chrysops dimidiata** and *Mansonioides uniformis*.

(2) Meko.

The southern part of this district is for the most part undulating, has a laterite soil, and is covered with open forest of a deciduous type, having an undergrowth of tall grasses and bush, with occasional belts of denser forest, the latter generally associated with the small streams. There are a number of small rivers running south, the chief of which are the Yewa and the Idi, which unite a little to the south of Egoa.

The town of Meko stands on the eastern edge of a large plateau 645 feet above sea level, with an estimated area of five square miles. To the west the descent is very precipitous to the small village of Idofa, nestling in the valley of the Oyo River, a tributary of the Yewa. The main road to Meko is from Aro a station in Egbaland on the Lagos Railway, 60 miles from the terminus at Iddo. Only 13½ miles of this road are in the Meko district.

No blood-sucking flies were seen at Meko during my visit, nor have any been recorded from the plateau itself. A number of species, however, occur at various places on the Aro-Meko road, but these will be referred to later. On the dogs, however, the following parasites were found :—*Haemaphysalis leachi*, *Rhipicephalus sanguineus* and *Ctenocephalus canis*, while on the fowls were numerous *Echidnophaga gallinacea*.

North of the town of Meko there is a small belt of oil-palms. "Further north, palms all but disappear, and the scenery becomes extremely monotonous—everywhere tall grass and trees of such a kind that the general aspect is like that of a thickly planted English orchard with its grass ready for haysel. Cropping up here and there are huge slabs of bare grey gneissic granite, and also hills of the same, partly clothed with trees and herbage ; these are seen best near Okuoshiju's farm and at Owuye (French, and 12 miles north of Meko). Numerous small streams run in all directions except north ; the largest is the Okpara, about 250 feet wide, between Jabata and Wasimi."

(3) Shaki.

This district is very imperfectly known, but the general configuration of the country is said to be similar to that described above for the northern part of the Meko district. The River Ogun rises in this district near the Northern Nigeria frontier.

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* It is very doubtful whether *C. silacea*, Aust., is really distinct from this species, and it is highly probable that when a larger number of specimens are obtained it will prove to be no more than a mere colour variety.

(4) Oyo.

The district of Oyo is very similar to Meko. The general type of country is undulating grass-land, sparsely timbered with gnarled and stunted trees. In the north and west there are high rocky hills, generally rising precipitously to a height of 200–300 feet, while scattered about are small patches of forest.

Game is fairly abundant in this northern region, in fact it is probably the best preserve in Southern Nigeria. The smaller antelope are found throughout the whole of these districts; elephant are fairly plentiful, while there are also a few lion, and leopard. Roan antelope, hartebeeste, waterbuck, kob and yellow-backed duiker are also to be found, while monkeys of various sorts are everywhere abundant. Nothing is known of the insect fauna of the country north of the Aro-Meko Road and west of the railway.

Again starting from the south we have now to consider Egbaland and Ibadan, two provinces within the basin of the Ogun River.

(5) Egbaland.

The southern portion of this independent kingdom ruled over by the Alake, whose residence is at Abeokuta, consists largely of forest, with immense tracts of open country, well watered and extensively cultivated. To the east are a few ranges of hills which separate the Ogun river system from that of the Ogbara, etc., a region abounding in thick forests. The north-eastern portion is open country, low, well watered and largely cultivated.

The Lagos Railway runs through a considerable part of this territory within a short distance of the capital, Abeokuta, which has a population of over 60,000. The town of Aro and the greater part of the Aro-Meko road is also in Egbaland, and here the following blood-sucking flies have been found :—

(In addition to those collected by the writer the records made by Drs. G. Gray and J. Copland, both of whom were stationed at different times at Aro, and who made large collections while travelling to and from Meko, have been added.)

At Aro :—*Mansonioides uniformis*, *Myzomyia costalis* and *Tabanus taeniola*. Both species of mosquito were very troublesome during the writer's sojourn in February.

At Olarunda market (one of the usual camping places on the Aro-Meko Road) :—*Hippocentrum versicolor*.

At Edi-Emi (the other camping ground on this road) :—*Glossina longipalpis*, *Tabanus subangustus*, *Hippocentrum versicolor* and *Subpangonia gravoti*.

At several other places on this road *Glossina longipalpis* has been found, while *Haematopota tenuicrus* has also been recorded.

From the dogs at Aro *Rhipicephalus sanguineus*, *Boophilus decoloratus* and *Ctenocephalus canis* have been taken, while on the sheep at Abeokuta, in addition to *Boophilus decoloratus*, I also found a new species of blood-sucking lice (Anoplura) recently described by Kellogg and Paine* under the name of *Linognathus africanus*.

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* Bull. Ent. Res. II, pt. 2, p. 146.

(6) Ibadan.

This district lies to the north of Egbaland and consequently partakes of the hilly character of that region. "The whole country lies on eruptive rocks all belonging to the granitic-gneissic family, with approaches here and there to porphyry. North of Ibadan there is little real forest. The country may be described as a rolling plateau with low hills and hardly any virgin land. The average rainfall is 40–50 inches. The cattle thrive although they have ticks and suffer from tsetse-fly, especially in the neighbourhood of rivers."

The only blood-sucking flies recorded from Ibadan are :—*Myzomyia costalis*, *Culiciomyia nebulosa*, *Tabanus taeniola*, *Haematopota decora* and *Hippobosca maculata*. Dr. Ashton informed me that "sandflies," probably *Culicoides grahami*, were very abundant, especially during the wet season and were most troublesome from 6 to 11 A.M. and from 3 P.M. to sunset. None were seen by me during my visit, which occurred towards the end of February.

(7) Ikorodu.

This is a very small district lying on the Lagos lagoon. The whole area is very low and there is no open country ; clearings for farms have been made in the forest in several places. Numerous rivers, streams and back-waters from the lagoon intersect the country in all directions, and these afford an ample water-supply. Many of these water-ways are navigable for canoes. Nothing is known of the insect fauna of this district.

(8) Epe.

The district of Epe extends along the sea-coast practically from Lagos to the boundary of the Central Province, and includes the two sub-districts of Mahin and Itebu. At no point is it more than twenty-five miles from the coast. Both of the sub-districts, Mahin and Itebu, are low-lying and swampy, the greater part of this area being covered with large trees and thick undergrowth. North of the town of Epe the country is undulating. It was once covered by a huge forest, which has now been cut down and replaced by farms. South of this region to the sea the whole country is low-lying and sandy, and includes numerous lagoons, the largest of which is known as the Lekki Lagoon. Numerous rivers, which rise in the districts to the north, such as Ibadan and Ondo, have their lower reaches in the Epe district, and pour their waters into the various lagoons. The largest of these are the Oshun, the Shasha and the Oni. In addition to these there are numerous creeks, such as the Unu, the Owa and the Mahin. Consequently, waterways are extremely numerous throughout the district and afford communication between Lagos, Epe, and onwards to the Niger.

The chief industry of the district is fishing, but there is also a certain amount of agriculture. Recently, bitumen has been discovered there, and this substance is being exploited by the Southern Nigerian Bitumen Company.

Elephant were formerly abundant, but are now practically extinct. A few antelope still exist, and hippopotami and manatee occur in the rivers and creeks. Our knowledge of the insect fauna of this district is due entirely to the work of

Dr. W. A. Lamborn, who has collected extensively on the Oni River. The following blood-sucking flies have been received from him : *Glossina caliginea*, *G. palpalis*, *G. nigrofusca*, *Tabanus fasciatus*, *T. secedens*, *T. socialis*, *T. thoracinus*, *Chrysops longicornis* and *C. silacea*. With regard to the last-named species he says : " This is the commonest biting fly found in the houses at Oni Station on Lekki Lagoon." Of the three species of *Glossina* which occur in this region *G. caliginea* appears to be by far the most abundant.

(9) Ijebu-Ode.

This district lies to the north of the western portion of the Epe district. The country is undulating and for the most part covered with thick forest ; there are no hills of any importance, and the whole region is well watered by small streams and several large rivers. These latter are the higher reaches of those mentioned in the Epe district.

Bush-cow and some of the larger antelope are found on the Oni river and the surrounding country, but on the whole the district is too thickly forested for game to be abundant. Crocodiles are scarce. Nothing is known of the insect fauna of this district.

(10) Ondo.

The district of Ondo is much larger than any of those just mentioned ; it lies to the north of the eastern half of the Epe district, and extends northwards to Ilesha. The country is hilly and undulating, and there are several large dense forests. To the north are the Idanre Hills, a range of granitic and gneissic rocks, the surrounding country being precipitous on all sides. These hills form the watershed between the river system of the eastern half of this Province and the system of the western half of the Central Province. The whole country is well watered, and there are several large rivers, the most important of which are the Oni, the Owena and the Onishere. The principal creek runs from Agbabu to a point where the Arogbo Creek flows westwards to Mahin and eastwards to Arogbo, and is navigable for steam launches.

Elephant and bush-cow are found in the Onishere and Idanre forests ; small antelope and leopard in the Ondo and Akure forests ; while crocodiles abound in the lagoons. Sheep, goats, pigs, and a small breed of cattle to which I shall refer later, are to be found in most of the villages.

The part of this district traversed by the writer was from Igbara-Oke through Akure to Owo. The only blood-sucking insect obtained was *Ctenocephalus canis* from goats at Akure. The forests of this province are probably the largest in the Colony, and would well repay examination from an entomological point of view.

(11) Oshogbo.

North of the districts just discussed lie Oshogbo and Ilesha, which extend to the Northern Nigerian frontier. Politically, Oshogbo is a sub-district of Ibadan, but for the present purpose it merits separate consideration, chiefly from the fact that the insect fauna of this area is, after Yaba, the best known in Southern Nigeria. Dr. T. F. G. Mayer, who was stationed here for some

time, made extensive collections and also bred numerous species of mosquitos from larvae. He has himself published a short report on his observations on the district in a previous number of this Bulletin,* so that it is unnecessary for me to enter into much detail here. I have, however, considered it advisable to include his list of blood-sucking insects for the sake of completeness, along with some other species collected by me during my tour in the district.

The country is for the most part covered with thick bush, and there is also a large number of oil palms. It is well watered by several large rivers, the most important of which are the Oshun, the Otin and the Shasha ; the first and last-mentioned of these we have now traced from their mouths to their source, from Epe through Ijebbu-Ode.

The country is undulating and there are no extensive swamps ; to the north-east are hills, which separate the Western Province from the Niger system ; to the north-west open grass country extends through the district of Oyo to the Shaki highlands ; to the south-east thick forest is found, merging into the forest region of the Ondo district.

Game is scarce, but a few antelope and some leopard are still to be found. Of the domestic animals the most common are sheep ; goats are also abundant, and in several places one finds a number of cattle, both the hump-backed or "Zebu" variety from Northern Nigeria, and the small native breed. Horses are often introduced from Northern Nigeria but seldom thrive.

The following blood-sucking insects have been found in the district, but I would draw attention to the paper, already cited, by Dr. Mayer on their distribution, numbers and seasonal prevalence.

Diptera.—*Glossina palpalis*, *G. longipalpis*, *Stomoxys brunnipes*, *Stomoxys nigra*, *Tabanus quadrisignatus*, *T. subangustus*, *T. pluto*, *Chrysops longicornis*, *C. silacea*, *Hippocentrum versicolor*, *Haematopota decora*, *H. tenuicrus*, *Culex decens*, *C. duttoni*, *C. pruina*, *C. tigripes* var. *fuscus*, *C. zombaensis*, *Myzomyia costalis*, *M. funesta*, *M. umbrosa*, *M. marshalli*, *Myzorhynchus mauritianus*, *M. paludis*, *Mansonioides uniformis*, *Culiciomyia nebulosa*, *Ochlerotatus nigeriensis*, *Stegomyia africana*, *S. fasciata* *S. sugens*, *Eretmopodites quinquevittatus* and *Uranotaenia mayeri*.

Siphonaptera.—*Ctenocephalus canis* from dogs.

Mallophaga.†—*Menopon nigrum* (a new species), *Nirmus varius*, and *Colpocephalum semicinctum* ; these were all obtained by the writer from a white-necked raven (*Corvultur albicollis*), and *Colpocephalum flavescens* which was found on a vulture.

Ixodoidea.—*Boophilus decoloratus* from cows, *Rhipicephalus simpsoni*, Nutt. and Warb., sp. n., on bush-rat and *Rhipicephalus neavei*.

It is interesting to note that from a bush-rat killed by me at Oshogbo, in addition to the new species of tick mentioned above, two new worms were also

* Bull. Ent. Res. II, pt. 3, pp. 273–276 (1911).

† Kellog and Paine, Bull. Ent. Res. II, 2, pp. 147–151 (1911)

obtained. These have been described by Dr. Leiper. Both belonged to new genera, one in the family ANCHYLOSTOMIDAE, *Acheilostoma simpsoni*, the other in the family STRONGYLIDAE, *Trachypharynx nigeriae*.

(12) Ilesha.

The district of Ilesha may be described as an undulating plain situated in the forest belt ; it is well watered by numerous streams and is surrounded on all sides except the north by ranges of steep hills. The rainfall is about 50 inches annually. Game is scarce, but a few antelope, some leopards and several species of monkeys are to be found.

The region known as Ekiti is separated from Ilesha by a range of precipitous hills, the Efon Range, of about 600 feet above the level of the surrounding country. The area to the south is covered with forest, with occasional stretches of low scrub. To the north, for the most part, the country is open, with small belts of forest along the water-ways. Three large rivers, the Oshun, the Ogbesse and the Owena rise in this district. Antelopes of all descriptions, bush-cow, leopard and pig are abundant. Our knowledge of the blood-sucking insects of the district is principally due to Capt. L. E. H. Humfrey, but collections have also been made by Dr. T. F. G. Mayer and Capt. A. H. Blair. The following are the chief species found among the DIPTERA :—*Glossina fusca*, *G. palpalis*, *Tabanus kingsleyi*, *T. ruficrus*, *T. pluto*, *T. besti*, *Chrysops silacea*, *Rhinomyza stimulans*, *Culiciomyia nebulosa*, *Stegomyia fasciata*, *Eretmopodites inornatus*, *E. quinquevittatus*, and *Mucidus mucidus*.

SIPHONAPTERA :—*Dermatophilus penetrans* and *Ctenocephalus canis*.

MALLOPHAGA :—*Trichochetes climax*, on goats.

IXODOIDEA :—*Rhipicephalus sanguineus* and *Haemaphysalis leachi*.

There remain to be considered only a few localities from which blood-sucking insects have been recorded, and which are not included in the foregoing sections. These are, Lagos, the capital of the Colony ; Yaba, the headquarters of the Medical Research Institute ; and a few isolated localities on the Lagos Government Railway.

(13) Lagos and Yaba.

From the town of Lagos itself the only blood-sucking flies so far recorded have been mosquitos. Recently Dr. W. M Graham undertook a mosquito survey of this town, and an account of his results has already been published in this Bulletin. It is, therefore, only necessary for me to give a list of the species found. They are as follows :—*Stegomyia fasciata*, *Culiciomyia nebulosa*, *Culex duttoni*, *Culex tigripes* var. *fuscus*, *Culex decens*, *Myzorhynchus obscurus* and *Myzomyia costalis*. I may also mention that while resident at Yaba I obtained numerous fleas from rats sent to Dr. Connal for examination. These were all *Xenopsylla brasiliensis* with the exception of one male *Xenopsylla cheopis*, the transmitter of plague. I believe this is the only record of this flea from Southern Nigeria, though it is very common on the Gold Coast.

The insect fauna of Yaba, about five miles from Lagos and close to the railway, is better known than that of any other part of the Colony, owing to the fact that the Medical Research Institute is erected there. Not long ago Dr. W. M. Graham, assisted by Dr. A. Connal, made exhaustive collections of mosquito larvae, an account of which was published in this Bulletin* by Mr. W. Wesché. Since that time numerous other species, both imagines and larvae, have been received and the complete list is as follows :—*Toxorhynchites brevipalpis*, *Culex consimilis*, *C. pruina*, *C. guiarti*, *C. grahami*, *C. quasigelidus*, *C. duttoni*, *C. tigripes* var. *fuscus*, *C. decens*, *C. invidiosus*, *C. thalassius*, *C. rima*, *Culiciomyia nebulosa*, *Ochlerotatus caliginosus*, *O. longipalpis*, *O. irritans*, *O. domesticus*, *O. punctothoracis*, *O. nigricephalus*, *O. marshalli*, *Stegomyia africana*, *S. apicoargentea*, *S. fasciata*, *S. luteocephala*, *Aëdomyia catasticta*, *Banksinella luteolateralis*, *Taeniorhynchus aurites*, *T. annetti*, *T. violaceus*, *Myzorhynchus umbrosus*, *M. mauritianus*, *Myzomyia costalis*, *Nyssorhynchus pharoensis*, *Mansonioides uniformis*, *Eretmopodites inornatus*, *Mimomyia mimomyiaformis*, *Uranotaenia balfouri*, *U. coeruleocephala*, *U. annulata*, *Ingramia nigra* and *I. uniformis*.

Collections from this locality have also been received from Drs. A. Connal and W. H. Sieger, and from these and the species collected by the writer the following list of blood-sucking insects, other than mosquitos, has been prepared :—

Diptera :—*Tabanus billingtoni*, *T. ditaeniatus*, *T. fasciatus*, *T. ruficrus*, *T. laverani*, *T. par*, *T. pluto*, *T. secedens*, *T. subangustus*, *T. taeniola*, *T. thoracinus*, *Chrysops longicornis* and *Hippocentrum versicolor* ; *Glossina fusca* (a single specimen caught by the writer on April 20th, 1910), *Stomoxys calcitrans*, *S. nigra*, and *S. omega* ; *Hippobosca maculata* on cattle ; *Nycteribia sp.* on bats.

Siphonaptera :—*Ctenocephalus canis* from dogs.

Ixodoidea :—*Amblyomma variegatum* and *Rhipicephalus sanguineus* on dogs.

(14) Lagos Railway.

The following records from construction camps and stations on the Railway are also worthy of note. At Agege, the source of the new water-supply for the town of Lagos, twelve miles from Iddo, the railway terminus, *Glossina fusca*, *Stomoxys nigra*, *Tabanus taeniola* and *T. pluto* have been caught, while between this point and Aro, sixty miles from Lagos, *Hippocentrum versicolor* was obtained in a railway-carriage at Owowo, and also at a camp 2½ miles from Aro. From Opelifa Dr. G. M. Gray records *Tabanus fasciatus*, *T. taeniola* and *Hippobosca maculata*, as well as the following ticks from horses :—*Amblyomma variegatum*, *Boophilus decoloratus* and *Rhipicephalus sanguineus*. At Opeji, *Dermatophilus penetrans* was found, while from the eighty-five mile camp *Stomoxys nigra* has been recorded. At Olokemeji, the headquarters of the Forestry Department, about midway between Aro and Ibadan, the only blood-sucking insects recorded are *Tabanus taeniola* and *T. socialis*. During my visit there, however, I saw several tsetse, and, though I was unable to obtain any, am of opinion that they were *Glossina longipalpis*.

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* Bull. Ent. Res. I, pt. i, pp. 7–50 (1910).

(*b*) *The Central Province.*

Owing to the irregular shape of the colony, this Province is situated to the south-east of the Western Province. It extends inland from the Bight of Benin to the Provinces of Kabba and Bassa in Northern Nigeria, and is bounded on the east by the Eastern Province of Southern Nigeria. Its area is roughly about 21,000 square miles and it is therefore slightly smaller than the Western Province ; the total population is approximately 2,000,000.

The physical configuration is far from uniform, and four distinct types may be observed. In the north, but more especially in the north-west, the geological formation is igneous ; the country is slightly elevated, consisting of a series of plateaux, rounded hills and ridges, and thus forms a continuation of the type to be found in the north-west portion of the Western Province and the southern parts of Northern Nigeria.

The second type of formation occupies by far the largest area in the Province, and consists of a sandy stratum of considerable depth, apparently formed from the débris of the igneous rocks. Boulders and stones are absent, and the colour of the soil is light and reddish.

More recent in formation is the alluvial deposit, consisting of sand with overlying strata of mud, to be found in the valley of the Niger ; while along the coast is the great mangrove belt, in some parts over thirty miles in width. This area is intersected by the numerous mouths of the river and is being gradually built up by a deposit of silt brought down from the higher reaches and bound together by a dense growth of mangroves.

The nature of the vegetation varies in accordance with the different types of country described. In the delta the mangrove holds exclusive sway, while further up the river, and in the valleys where the air is more humid, there is a dense forest belt consisting of moderately large trees, thick low scrub and a tangled, impenetrable network of lianes and creepers. Further from the river are to be seen large trees with little undergrowth, while in the north-east and north-west the forest is of a deciduous type, and the country is consequently orchard-like and open. Scattered about in this last area are extensive stretches of tall elephant grass.

The main water-way in the Central Province is the Niger, the upper reaches of which I have described in a previous report.* This river enters Southern Nigeria near Idah and flows practically due south to Abo, where it breaks up into innumerable branches, some of which flow through the Central, and others through the Eastern Province, the whole forming the extensive region known as the Niger delta.

In the upper reaches it receives a considerable number of small tributaries. On the left bank the only one of any great importance is the Anambra River, which rises in Bassa Province in Northern Nigeria, and after flowing in a southerly direction enters the Niger near Onitsha. On the right bank the largest tributary is the Aseh River, which joins the Niger near Abo.

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* Bull. Ent. Res. II, pt. 4, pp. 315–318.

South of Abo the true delta of the Niger commences, and the various outlets to the sea have received definite names. The first of these to be navigated was what is known as the Nun entrance in the Eastern Province, but this channel has been abandoned for some time in favour of a larger one, which enters the sea at Forcados. Consequently, the Niger as a river navigable for large craft may be said to be almost entirely confined to the Central Province.

Most of the large ramifications in the delta area have been named after the chief towns which they pass, for example, the Benin River, the Warri River, the Forcados River and the Sapele River, while others are known as the Escravos River, the Ramos River and the Dodo River. These are all in the Central Province, but it must be remembered that they are in reality only creeks in the delta, which receive the subsidiary waters of the smaller streams in the Province, and are not in themselves distinct from each other.

The high lands of Ishan, Agbor and Kwale form a dividing line between the tributaries of the Niger which flow to the east and the numerous small streams which are directed westwards. Of the latter the most important is the Ovia River, which rises in the Kabba Province in Northern Nigeria, and, after flowing practically due south, pours its waters into the Benin River. Its chief tributary is the Ogbesse River, which rises in the Ilesha district in the Western Province, and enters the Central Province between Akure and Owo. The Osiomo River, which passes Benin City, also flows into the Benin River, and further east the Jameson River and the Ethiope River unite to form the Sapele River, which again in turn joins the Benin River. The River Warri rises in the Kwale district and enters the system of creeks near the town of the same name; this again joins the Forcados River before entering the sea.

It will thus be seen that the river-system of the Central Province is a very complicated network of creeks, fed chiefly by the Niger, but also to a certain extent by several small streams from the north-west. These creeks are connected with the series of lagoons in the Western Province which have been already described, and also with similar creeks in the Eastern Province, and it is thus possible to pass by launch from Badagri in the extreme West to Calabar and eventually to the Kamaruns without entering the open sea.

Politically, the Central Province is divided into 15 districts, each of which I now propose to discuss in turn as briefly as possible. For the present purpose, they may be conveniently divided into five groups, in accordance with the various types of physical configuration already discussed.

(1) Ifon and Benin.

This region is comparable in many respects, and geographically is coterminous, with the Ilesha district in the Western Province. To the north and east of Ifon the country is open and hilly, while in the Kukuruku country, which extends into the Kabba Province of Northern Nigeria, it is very rocky. To the south and west there is extensive thick bush and large timber forests, which gradually merge into the Forests of Ondo, referred to elsewhere. Game is abundant. Elephant, leopard, buffalo, hartebeeste, waterbuck, duiker, harnessed antelope, wild pig and baboons are all said to occur. No tsetse have been recorded from this

region, but while at Ifon I saw several, though unfortunately was unable to secure specimens for identification. It is more than probable, however, that these were *Glossina longipalpis*, but they may have been *G. submorsitans*.*

Two large rivers, the Owon and the Ovia and several small streams were crossed between Owo and Ifon, but no tsetse were seen at any of the fords. The only blood-sucking insect so far recorded from Ifon is *Tabanus besti* caught by Dr. R. W. Gray in December, 1910.

The most noteworthy feature in this district is the presence of large herds of a dwarf variety of cattle, which, according to native evidence, supported by a low rate of mortality, seems to be immune from trypanosomiasis. Throughout Northern Nigeria and in the parts of Southern Nigeria where cattle are found the predominant variety is of the Indian zebu type, usually white, with a large dorsal hump (Pl. II). A second variety, with a straight back, is also to be seen but in smaller numbers. These are all very susceptible to trypanosomiasis and readily succumb when introduced into a tsetse region. In the districts of Ondo, Ilesha, Ifon, Ishan in Southern Nigeria, and in the Kabba and Bassa Provinces of Northern Nigeria, all forested regions and tsetse habitats, this peculiar dwarfed variety with short legs may be seen in numbers. Their appearance is remarkable. The predominant colours are black and white, black, and, more rarely, brownish; there is no dorsal hump, and the forequarters are generally lower than the hind. The accompanying photograph (Pl. III) was taken by Mr. Sciortino, Assistant Resident in the Kabba Province, and gives a good idea of the build of these animals. Although this variety thrives well in the regions named, animals of either of the other types, immediately after being introduced, develop trypanosomiasis and die.

The goats in these districts are also short-legged and diminutive, and a dwarf variety of horse is said to be bred for use at Ondo. Imported horses at once succumb to trypanosomiasis.

Benin.—The country around Benin City, a very old and important town, is gently undulating, with a gradual slope to the sea. It is intersected by deep valleys, in each of which runs a small stream or river. Where not cultivated, the country is covered with a dense evergreen forest. The waterways connecting this region with the delta are very important, and, as they have a marked influence on the fauna, deserve some mention here. The Osiomo River (the lower part of which is known as the Olagi Creek), running into the Benin River below Koko Town, is fed by several branches, the Ogba, Ikpoba, Ohuma and Ohe Rivers. The Osiomo itself is navigable to Ologbo, about half-way between Benin City and Sapele, by launch, thence up to the Ikpoba by canoes to within 2½ miles of Benin City. The Ogba River is navigable by launch to Ogwosala, thence by canoe to Irishi, which is only four miles from Benin City. Sapoba is reached by launch on the Jameson River. The Ovia is navigable to a short distance below Ikoru for launches, and to a little below Gilli-Gilli for vessels drawing 12 to 13 feet.

[* Mr. J. H. J. Farquhar has sent *G. palpalis* from Owo and Afuge in the Ifon District, and *G. longipalpis* from Ifon itself; while *Chrysops dimidiata* was obtained by him at Ojalla. These insects were taken in February and March, 1912.—Ed.]

At a small stream about 13 miles from Benin City, on the road to Ifon, I caught one *Glossina pallicera*, the only specimen of this species so far recorded from Southern Nigeria. In Benin City itself *G. palpalis* was caught in several places, including the Rest-house and the Hospital, while at the River Ikpoba, the water-supply of the town at the time of my visit, *Glossina caliginea* was far from common. *Stomoxys calcitrans* and *Stomoxys nigra* were also abundant, especially in the stables, and the dogs and cattle were infested with *Rhipicephalus sanguineus*. At Ologbo, on the River Osiomo, about midway between Benin City and Sapele, *Chrysops silacea*, *Tabanus billingtoni* and *T. thoracinus* were obtained, while Dr. R. W. Gray records *Glossina longipalpis* from a place about 15 miles north-east of Benin City, and *Chrysops silacea* (or *dimidiata*),* *Tabanus billingtoni*, *T. fasciatus*, *T. secedens* and *Glossina palpalis*, from Ohere not far from Benin City.

With regard to the districts of Benin City and Ifon he says :—

"So far as my experience goes the fly [tsetse] area is coterminous with the extent of these districts. I have not yet visited a place in either without noticing these flies. . . . I am of opinion that they deposit their larvæ at places other than those near streams. . . . Cattle live and breed in the district. They are to be met with in most or in all the villages. These cattle have a healthy appearance. There is a herd of cattle at Benin belonging to the Government. They are all in good condition and breed freely."

(2) Sapele, Warri and Forcados.

The second group of districts may be considered as being almost entirely in the delta region. Warri and Sapele stand at the northern limit, and Forcados at the southern, or coast margin. The country around Sapele is for the most part low-lying and swampy, and is intersected by innumerable creeks forming a perfect system of water-transport. Ocean-going steamers can ascend to the town of Sapele. The mangrove forest extends for some 20 miles from the sea, and then gives way to forest land which is extensively farmed. A large amount of mahogany has been exported from this region. Cattle, goats and sheep are kept, but in small numbers. Leopard and antelope are said to occur in the denser bush ; crocodiles are abundant in the lower reaches of the Benin River and in the creeks near the sea.

Sapele.—*Glossina palpalis* has been caught at Sapele, but apart from this species the only blood-sucking insect so far recorded is *Chrysops silacea*. With reference to the bionomics of the latter species, I would draw attention to the following quotation from a letter received by me from Dr. Kelleher, who was stationed at Sapele for some time. "This fly appears at Sapele for a short visit twice yearly . . . It appears for a few weeks at a time at the beginning of the rains and at one other period which I am unable to fix. The natives in their tongue call it the 'softly-softly fly,' owing no doubt to its noiseless flight and gentle method of alighting. It usually hangs about the under parts of chairs and desks, and quietly and persistently flits to the ankles or the fingers, especially

* It is far from certain whether these two species are distinct.

if these are hanging down and not under care of the sight. By nature it is an out-door fly and only a short visitor to residences. It is more prevalent in the haunts of cattle. It does not attack people in the open, only in houses or closed canoes, and I think only in clear daylight, preferably the cool of the afternoon, after 3 p.m. It causes very considerable petty oedema of the part bitten, which does not disappear for a day or two, and sometimes bears a rough resemblance in size to 'Calabar Swellings.' When it is squashed while feeding, the contained blood is considerable."

Warri.—The country around Warri is very low-lying and exceedingly swampy in the rains ; in most places the paths used during the dry season are flooded and often impassable in the rainy season. The whole district is intersected by a network of rivers and creeks which are navigable for canoes and launches. Communication can thus be effected between Warri and such distant towns as Lagos, Forcados, Abo and Brass, the journey by water to the last-mentioned place being over 200 miles.

The natives belong chiefly to the Sobo and Ijaw tribes ; the former are more agricultural and inhabit the north and north-east, while the Ijaws are fishermen and live on the creeks in the south and south-west. All are of a very low class, unintelligent and of dirty habits, for which they can hardly be blamed considering the natural characteristics of the country in which they live.

Glossina palpalis, *Tabanus fasciatus*, *T. taeniola* and *T. secedens* swarm in all the creeks and backwaters.

Forcados.—Forcados is the principal shipping port of Southern Nigeria, and also the largest on the West Coast of Africa. No matter how efficient the railway system from Lagos may become, this township will always retain its position as the chief outlet for produce from both Northern and Southern Nigeria. It is now the headquarters of the Customs, Postal, Marine and Transport Departments of the Central Province, and the European population, both official and commercial, is increasing annually. Recently the Government removed their large engineering works from Akassa to Forcados and erected a slipway ; while a private firm owns a large dry-dock capable of taking ships up to about 2,000 tonnage. At present, there are over forty Europeans stationed permanently at Forcados, while the temporary European population as represented by the crews and stewards on steamers sometimes amounts to several hundreds. The native government staff, the employees of the various commercial firms, and the resident population exceeds two thousand.

The surrounding country is composed of swamps and a network of creeks. The town itself is situated on the left bank of the Forcados River about 8 miles from its mouth. Like Lagos, it is built on an island, which, prior to European occupation, consisted of an extensive mangrove swamp, and at the present time the greater part of it still remains in its original marshy condition. The town was created to meet a demand, and is purely artificial. The undertaking was an enormous and costly task and is yet far from complete. Drains had to be cut, roads had to be made, and before buildings could be erected the level of the ground had to be raised considerably. During the rainy season the whole island, with the exception of those raised parts, is under water, and the drains empty

and fill up with each fall and rise of the tide. The reclamation of land is slowly progressing and an extensive sea-wall is being built. When this is completed, and the level of the whole island raised a few feet by means of sand pumped from the sea, Forcados may then claim the title of a town. Sanitary work, so far as such is possible in the present conditions, is very efficiently carried on by the District Medical Officer, Dr. R. W. S. Smythe, but the total effect of keeping down mosquito breeding in native compounds is almost negligible in view of the enormous breeding-areas supplied by the omnipresent marshes. Nor is the drainage of these possible in the present conditions, and, except in a few cases, the employment of kerosene would be extremely expensive and almost useless.

Tsetse are everywhere to be found, and the number of mosquitos, both species and individuals, is enormous. These include *Myzomyia funesta* and *Stegomyia fasciata* in large numbers. Malaria is rife, and the possibility of yellow fever establishing itself in such a place is greatly to be dreaded. Recently a quarantine hospital was built on one of the creeks which flows into the Forcados River.

The Government of Southern Nigeria is fully alive to the necessity of reducing the amount of swamp on the island by means of a general elevation of the whole area, and no time should be lost in effecting this most urgent sanitary improvement. The risk to human life in the present state of affairs is the most cogent reason for advocating immediate and unceasing reclamation.

The following list of blood-sucking arthropods found in Forcados may exemplify more definitely the exact state of affairs :—*Glossina palpalis*, *G. caliginea*, *Tabanus fasciatus*, *T. par*, *T. secedens*, *T. socialis*, *T. taeniola*, *T. thoracinus*, *Banksinella luteolateralis*, *Ochlerotatus nigricephalus*, *Culex decens*, *C. insignis*, *C. invidiosus*, *C. rima*, *C. thalassius*, *Culiciomyia nebulosa*, *Myzomia costalis*, *M. funesta*, *Myzorhynchus umbrosus*, *Stegomyia africana*, *S. fasciata*, *Culicoides grahami*, *Ctenocephalus canis*, and *Rhipicephalus sanguineus*. One Muscid larva (probably *Cordylobia*) was taken from the breast of a European.

There are no large towns in the district. The natives are chiefly Ijaws, and live in small hamlets on the banks of the creeks ; their only industries are fishing and canoe-making.

Burutu is situated on the Forcados River a few miles above the town of Forcados. It is the headquarters of the Niger Company, and the Northern Nigerian Marine also have a station there. The mail-steamers ascend to this point for cargo and tie up alongside the wharf. The land is raised above the water-level, but is surrounded by mangrove swamp and dense bush, a large part of which ought to be cleared and the area drained. This "beach" is also a pestilential mosquito haunt, and most of the species obtained at Forcados were also found here. Between these two places the bank of the river is densely covered with mangrove (Pl. IV, fig. 1), and launches passing to and fro are invaded by swarms of *Glossina* and *Tabanus*. Nowhere in Southern Nigeria is there such a pressing need for systematic sanitary work as at these two places.

(3) River Niger.

The third group of districts in the Central Province comprises those through which the River Niger flows, and in order to form a narrative continuous with

the Northern Nigerian portion,* I have purposely started with the most northerly, namely, Idah. On the left bank the nature of the vegetation near the river is principally thick bush, but further inland it becomes more open, and the country is in parts very undulating and hilly. The town of Idah itself is situated on a cliff about 160 feet high. The vegetation on the right bank is very similar to that on the left, but inland the country develops a very hilly character, culminating in a range of hills running almost due north and south, known as the Kukuruku hills. The rivers draining this region all flow into the Niger, and include the Ofu, the Obe, the Ogio and the Orle. This district is said to be well stocked with game, including buffalo, water buck, hartebeeste and various other kinds of antelope. Goats and sheep seem to thrive, but cattle are far from common. *Glossina palpalis* and *Tabanus fasciatus* are the only two blood-sucking flies so far recorded from this region.

The Onitsha district is hilly and open ; clumps of forest are met with only in the vicinity of towns and along the banks of rivers and creeks. It is well watered ; the chief rivers are the Anambra, which flows from the north-east and enters the Niger above the town of Onitsha ; other rivers are the Idi-Minni, the Orashi and the Oderiji. In addition to these there are innumerable streams containing, for the most part, excellent water. *Glossina palpalis* abounds along all these water-courses.

The larger mammals of the district include bush-cow, leopards, antelopes, hippopotami, and monkeys. There is a considerable number of the small breed of cattle referred to before, and these seem to thrive well, while goats and sheep are prolific ; ponies die off soon after arrival. With regard to Onitsha, Mr. D. C. Price, District Commissioner, says :—"In 1903, the Government imported a herd of West Indian cattle—some 25 in all. They were put down at Onitsha and in little more than a year all were dead."

Between Illah and Onitsha both *Glossina palpalis* and *Tabanus subangustus* were caught on the steamer, while at Illah itself *Tabanus fasciatus* was obtained. At Abutshi, near Onitsha, *T. subangustus* has also been found. The most prevalent mosquito at the town of Onitsha was *Mansonioides uniformis*, but other species found were :—*Culex grahami*, *C. invidiosus*, *Culiciomyia nebulosa*, *Myzomyia costalis*, *M. funesta* and *Taeniorhynchus aurites*. A species of *Phlebotomus* was also troublesome ; and numbers of *Auchmeromyia luteola* were caught. On the dogs, sheep and goats were numerous *Ctenocephalus canis*, *Rhipicephalus sanguineus* and *Haemaphysalis leachi*.

Asaba.—This is a purely agricultural district situated on the right bank. The interior has only recently been opened up and the headquarters transferred to Agwashi Oku. The main importance of the district lies in the fact that lignite has recently been found in such quantities and of such quality as to justify the Government making a metalled road from Asaba to a central point in the seam at Okpanam, eight miles out. Lignite has also been found in the north of Asaba district, between Okunzu and Ibu, and this may result in opening up this hitherto practically unknown country. Near Asaba *Glossina palpalis* and *Mansonioides uniformis* were obtained.

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* Bull. Ent. Res. II, pt. 4, p. 315.

Abo.—To the south of Onitsha and Asaba lies the district of Abo, where the true Niger may be said to end and the delta begin. The whole of the country is low-lying, and during the annual rise of the river a large portion is submerged. The Niger flows down the centre of the district and there are numerous streams, offshoots of the river, ramifying throughout the whole country ; these are all navigable by canoe and many of them by launch. The country is well wooded, but, owing to the native system of continually clearing new ground for farms, none of the bush is of any great age and there is no primeval forest.

The main water-ways are the Niger and its tributary the Aseh River ; the latter is navigable by launch only during the wet season. During the dry months paths connect most of the villages ; of these paths those near the Niger are merely dried water-courses, but those on the West of the Aseh River and on the high ground in the north-east are passable all the year round. This district abounds in game ; antelope, bush-cow, leopard and baboons are plentiful, while elephant have been seen ; crocodiles and hippopotami are abundant in the river and creeks.

Sleeping sickness has been recorded from this district, while malaria, elephantiasis and filariasis are all common. The natives are good fishermen, and spend a considerable part of their time in canoes.

Glossina palpalis is almost universally distributed in the district, but is extremely abundant in the Aseh Creek. Specimens have been taken at Manunkor, Isilegu and Ebuka, the last two places being in the Aseh Creek. Other biting flies caught on or near the river in this region include :— *Tabanus fasciatus*, *T. secedens*, *T. taeniola*, *Rhinomyza stimulans* and *Glossina longipalpis*.

(4) Kwale, Agbor and Ishan.

Removed from the Niger on the right bank are the districts of Kwale, Agbor and Ishan. Only one of these, namely Agbor, did I manage to visit, but the following notes will serve to indicate the nature of the country and its vegetation. Practically nothing is known of the entomological fauna of any of these districts.

Kwale.—The country is undulating, rising gently from Okpara in the south-west to Usonigbe in the north, with depressions in the valleys of the Ethiope and Ihimi Rivers. In the north-east, and in the region of the Ethiope River the country is dry, but the portion to the south of the Ihimi country is swampy. The Ethiope River is navigable from Sapele to Kokori waterside for launches, to Kwale for pinnaces, and to Obiariki for large canoes. The Ihimi River is not navigable ; it is overgrown by dense foliage and is dry except in the rains. Game is said to be scarce.

Agbor.—This district is accessible either from Asaba, on the Niger, or from Sapele or Benin City, in the south. The country generally is undulating and there are no hills worthy of mention ; it is badly watered. The vegetation is of a thick bushy character, which in parts carries heavy timber. The River Osiomo, on the eastern boundary, has recently been cleared and permits of large canoe traffic for the transport of produce to Sapele and Benin City. *Glossina palpalis* was obtained at the town of Agbor.

Ishan.—This country is undulating and badly watered; bush prevails over two-thirds of the district. The River Osiomo, in the south-west, and the Attowar, which rises at Ubiaja and joins the Niger at Illah, are navigable for canoes, the latter however only as far as Evua, a distance of some thirteen miles from Ubiaja.

Game is said to be abundant, and includes elephant, bush-cow, red river hog, kob, hippopotamus, roan antelope, bush-buck, water-buck and leopard. *Glossina palpalis* has been recorded from the district, but the information lacks preciseness.

(5) Awka, Udi and Okwoga.

The last group includes the three above-mentioned districts, which all lie east and north of Onitsha.

Awka.—The country is undulating; in the north-east there are high hills and small plateaux. The towns are, as a rule, surrounded by bush, but the country between the towns is open. In the north there are extensive grassy plains and the area of bush diminishes. The only navigable water-ways are the Omerun River and the Anambra River.

"The domestic live-stock consists of cattle, sheep and goats. The cattle are a very good example of the African type, and some towns possess considerable herds. Goats are plentiful, but sheep scarcer. No definite evidence that tsetse-fly occurs is in existence, but the mortality amongst horses is probably due to it. Game is not plentiful. Hippopotami are found in the rivers and creeks in considerable numbers. Deer [sic] are to be found in the north. Bush-cow are found in fair numbers in the northern part of the district near the rivers." (H. N. Thomson.)

Udi.—The country is for the most part hilly, with open stretches covered with grass and patches of thick bush, in which the natives build their towns. These patches are generally from five to seven miles long and one to three miles wide (*cf.* the "kurimi" of Northern Nigeria). Various species of buck occur, and in the northern part elephant and leopard are to be found.

Okwoga.—This district has only recently been opened up, and little or nothing is yet known about it.

(c) *The Eastern Province.*

The Eastern Province is situated to the south and east of the Central Province and extends inland from the Bight of Biafra to the southern boundary of Northern Nigeria. On the east it is bounded by the German Colony of Kamerun and on the west by the Central Province of Southern Nigeria. Its area is over 29,000 square miles, and it has a population of over two millions.

In the west the country is, generally speaking, flat and much intersected by creeks. The eastern portion is undulating, and in the extreme eastern part becomes hilly. From the sea-board up to about the sixth parallel the forest belt prevails, and thence northward grass country is met with.

This province has three distinct river systems although, as has been already pointed out, in the coast area these are connected by a system of creeks. The

south-west portion lies in the delta of the Niger, the central part is drained by several small rivers, of which the largest is the Opobo (known in the north as the Imo), while the eastern part is in the Cross River drainage area. The names of the principal rivers from west to east are, the Dodo, Pennington, Nun (mouth of the Niger), Brass, Sombreiro, New Calabar, Bonny, Opobo, Kwa Ibo, Cross, Calabar and Great Kwa Rivers.

The Calabar and the Great Kwa are tributaries of the Cross River and enter it near its mouth, while the only tributary of any great size further north is the Ewayon in the Aro Chuku District, about 150 miles from the town of Calabar.

For administrative purposes the Province is divided into twenty-one districts, and these we will proceed to consider in six more or less geographical groups.

(1) Brass, Degema, Bonny and Opobo.

These four districts all lie within the eastern portion of the delta of the Niger, and commercially are very important. Large trading factories are situated throughout the various creeks and are reckoned the most unhealthy in Southern Nigeria, the percentage of malarial cases in this region being by far the highest for any part of the Colony. Within recent years enormous improvements have been made, more especially on the Government "beaches," but the state of clearing and general measures for the reduction of the number of mosquitos at most of the trading stations leaves much to be desired.

I was enabled to travel by launch for over a fortnight, visiting the various stations in this region, and Dr. Collett, who was stationed at Opobo during my visit, but who was afterwards transferred to Degema, has also collected and sent to England a large number of specimens of the various blood-sucking insects at these places.

The following short descriptions of the districts and the lists of insects found at the different parts will serve to show how prolific this region is in potential disease-carriers.

In the Brass District, the country is chiefly swamp, intersected by a regular network of creeks, and communication is effected between the various villages by launch or canoe. It is estimated that there are not over twenty miles of path in the district, and even these tracks are fit for use only during the dry season. Monkeys, hippopotami and crocodiles are almost the only large animals in this region, though elephant are occasionally seen. Cattle, sheep and goats are extremely rare.

The town of Akassa was, until recently, very important, but the marine engineering works which formerly existed there have now been removed to Forcados. Akassa is on the sea-coast and is accessible by ocean-going steamers.

Tabanus secedens, *T. socialis* and *T. thoracinus* are all common, while the mosquitos *Myzomyia costalis* and *Stegomyia fasciata* constitute a perfect pest. On the launch and even in the houses it was almost impossible to sit in the evening without having recourse to a mosquito-proof room.

The town of Brass is situated a short distance up one of the creeks, and here also the above-named insects were abundant, while *Glossina palpalis* was an additional scourge.

The greater part of the Degema district is composed of mangrove swamp, but in the northern portion there is some good high ground. This region is a bewildering maze of creeks, but wherever there is any solid ground one sees a small fishing hamlet and a few coconut palms. There is no attempt at agriculture, as the only parts above high water mark are occupied by huts. These hamlets swarm with noxious insects of all kinds, e.g., *Tabanus secedens*, *T. socialis*, *T. thoracinus*, *Glossina palpalis*, and *Stegomyia fasciata*; probably many more would be found if a thorough examination were made.

At the town of Degema, the following mosquitos, in addition to those mentioned above, were obtained, *Myzomyia costalis*, *Culex duttoni*, *C. tigripes* var. *fuscus*, *C. invidiosus*, *Ochlerotatus domesticus*, *O. nigricephalus* and *Taeniorhynchus annetti*.

Bonny is a small district comprising the port and island of Bonny. The country is all in the delta belt and is consequently very flat and swampy with occasional tracts of firm land. A considerable amount of reclamation has been done around the town and much low-lying ground has been raised, but this work is yet far from complete. Bonny is a regular port of call for mail boats, and all officials and others for the area under discussion trans-ship here. Consequently, it merits considerable attention from a sanitary standpoint. *Myzomyia costalis* and *Stegomyia fasciata* are both extremely abundant, as also is *Ochlerotatus nigricephalus*. Sand-flies are said to be very troublesome during the rains, but none were seen during my visit in the month of May.

The district of Opobo lies to the east of Bonny around a river of the same name, which rises in the hinterland, where it is known as the Imo. It is connected by creeks, however, with the Niger delta area, though topographically distinct from it. There is a regular launch service through these creeks between Bonny and the town of Opobo, the headquarters of the district at the mouth of the Opobo River. Near the coast, the land is covered with mangrove swamp intersected by occasional patches of sandy soil; further inland, in the north and east, the country is undulating; in the west it is very low-lying and swampy during the rains.

Cattle, sheep and goats are kept, but in small numbers. Elephant, hippopotami, crocodiles, antelope and pig are to be found in the Andoni portion of the district—a marshy stretch of country near the sea.

On the launch, between Bonny and Opobo, the following blood-sucking insects were found:—*Glossina palpalis*, *Tabanus secedens*, *T. socialis*, and *T. thoracinus*; while at Opobo itself, in addition to these, *Tabanus argenteus*, *Chrysops longicornis*, *Culex guiarti*, *Culiciomyia nebulosa* and *Stegomyia fasciata* were obtained. Similarly, during the journey by launch up the river Opobo to Akwete *Tabanus secedens*, *T. socialis* and *Glossina palpalis* flew aboard in numbers, while at the latter place *Tabanus obscurehirtus* and *Chrysops silacea* were caught.

The districts of Ahoada and Owerri lie north of a line drawn from Akwete and Degema, being inland from the delta, but in the basin of the Niger. During my visit to the colony I was unable to visit either of these regions, and so far no blood-sucking insects have been received from them. The following short description will, however, serve to show the nature of the country.

The whole district of Ahoada is flat and low; it lies between two rivers and is very swampy in the wet season. In certain parts, however, stretches of long grass are found as well as forest. Much of it is comparable to the "fadama" of Northern Nigeria, in which water lies to a depth of nearly six feet in the wet season, but which, during the dry season, is baked hard and cracked by the sun. The main river is the Sombreiro, which is navigable by launch as far as Ihoaba at all times of the year, by canoe during the rains to the source of the Nkissi River, and in the dry season at least to Ikri. Leopards, bush-cow and antelope are not uncommon, while elephant are occasionally encountered in the Anenzoh country.

The district of Owerri is flat and sandy, and is covered for the most part with thick low bush. Goats, sheep and cattle are kept, but horses do not thrive. Buck of various sorts are common, as also are leopards, while hippopotami are occasionally seen near Oguta.

(2) Eket.

To the east of Opobo is the district of Eket on the Kwa-Ibo River. This river, like the Opobo, rises some distance from the coast and is independent of either the Cross River or the Niger, that is, it pours its waters direct into the sea near the town of Eket. The southern half of the country is low-lying, wet and swampy, and covered with virgin forest. This part is practically uninhabited, and, except on the coast where fishing huts are to be found at intervals, no natives exist. The remainder of the district is covered with low bush cut every few years for cultivation.

Capt. L. E. H. Humfrey, District Commissioner in S. Nigeria, was stationed here for a short time and found the following blood-sucking insects:—*Tabanus secedens*, *T. socialis*, *T. obscurehirtus*, *T. obscurefumatus* and *Chrysops silacea*. With the exception of these records the entomology of this district is absolutely unknown.

(3) Aba, Ikot-Ekpene, Bende and Okigwi.

The districts in the next series are all inland, being situated between the Niger and the Cross River.

The most southerly is Aba, which lies on the river of the same name, a tributary of the Opobo, while Okigwi, the most northerly, is situated at the head waters of the River Opobo, known in its upper reaches as the Imo. The Bende district is not far from the head of the Enyong Creek, a tributary of the Cross River, while Ikot-Ekpene also lies in the basin of the same river.

Aba.—Around Aba the country is flat, for the most part waterless, and covered with low scrub or else under cultivation. Groups of large trees at market-places serve to show how dense must have been the forest at one time. A large navigable river, the Imo, forms the western boundary; the Aba River flows through the central part of the district, and the Achacha River, which joins the Kwa-Ibo River near Itu, forms the eastern boundary. These rivers form practically the only water-supply of the district, Goats, sheep, pigs and dogs are common, but horses do not thrive. Leopards, antelopes and monkeys are to be found in the district.

Not far from Akwete, on the Opobo River, *Glossina palpalis* occurs, while in the drier regions *Chrysops silacea* is not uncommon. At the town of Aba, in addition to the latter species, only one blood-sucking insect was seen, namely the mosquito *Myzomyia pitchfordi*, a by no means common species.

Ikot-Ekpene.—"The country on the right bank of the Enyong River, extending about 12 miles inland, consists of a succession of hills rising gently from narrow valleys watered by several small streams, choked with palms and other vegetation, and swampy in the wet season. The height of these hills is 200–350 feet. The rest of the district is a tableland, elevated about 200 feet above sea level, broken by the valley of the Kwa-Ibo River, four miles west of Ikot-Ekpene and by that of the Achacha River on the western boundary. All over the district, except for a narrow fringe along the right bank of the Enyong, the original forest has long ago been cleared away for cultivation, and the only large trees remaining stand in town places, burial groves and market-places. The whole country is a patchwork of fields, in various stages of fallowness, clumps of bushes with tall grass and herbage growing between. The sub-soils are loam and sand on a base of sedimentary rock. During the dry season (November to March) water is extremely scarce in the southern and central parts—no village, however, is more than a few hours' walk from some stream. There is nowhere any collection of huts large enough to be called a town; each village community consists of a number of isolated family compounds, separated from one another by groves of bush and small patches of crops."

No Tabanidae, *Glossina* or Anophelines were seen during a week's stay in this district, but Culicines were very abundant. The following species were found:—*Culex duttoni*, *C. grahami*, *C. insignis*, *C. tigripes* var. *fuscus* and *Culiciomyia nebulosa*. The only other blood-sucking insect obtained was *Ctenocephalus canis*, but *Culicoides* is said to be very troublesome during the rains.

Near the European quarters there is a large swamp which constitutes the main breeding-ground for mosquitos, but the abolition of this within a short period is almost impracticable without an enormous outlay. A certain amount of work has already been accomplished, which has resulted in the area being considerably diminished. Both the political and medical officers on the station are fully alive to the necessity of a still further reduction, and it is to be hoped that an annual grant may be voted to carry on the work so efficiently begun. In the pools of water in this swamp large numbers of a small fish, *Hemichromis fasciatus*, belonging to the family Cichlidæ, abounds. Mr. G. A. Boulenger in a letter to me with regard to this species says "This fish, known to take a fly, must, in my opinion, be a good mosquito-larvae destroyer." Every effort should therefore be made to prevent its destruction.

Okigwi.—The Okigwi district lies at the head of the River Imo and is consequently in the same river system as Opobo and Owerri. The country is covered for the most part with thick bush, but scattered about are open patches, while in the north it is very hilly, with rolling grass plains. Near the River Imo there are extensive swamps during the rains.

This region I visited during the dry season, when insect-life was far from plentiful. No biting flies were seen at the station of Okigwi, but in a large

swamp, about nine miles away on the road to Afikpo, the source of the River Ivo, which flows into the Imo, *Glossina palpalis* and *Hippocentrum trimaculatum* were abundant. At Ishiago, on the River Ivo, the same two species, along with *Tabanus secedens*, were taken, while, at this place also, jiggers (*Dermatophilus penetrans*) were a perfect scourge in the native-built rest-house. So abundant were they that in a small space on the ground dozens could be seen hopping about. The carriers suffered badly and for days afterwards kept continually extracting them from their feet. One man assured me that he took twenty-seven from one foot. The only remedy in such a case is the complete destruction of the house by fire. This I recommended to the Medical Officer of the district.

Bende.—This district lies in the drainage area of the Cross River. The country throughout is undulating and broken and is covered with light bush of the savannah-forest type, except near the water-courses, where it is very dense. At the time of my visit (May 1910), by far the commonest blood-sucking fly was *Hippocentrum trimaculatum*. In addition to those species seen by the writer, and two sent by Dr. Wilson, Dr. P. H. Macdonald made exhaustive collections, and from these sources the following list has been drawn up :—*Glossina palpalis*, *G. fusca*, *Chrysops silacea*, *Hippocentrum trimaculatum*, *Tabanus besti*, *T. kingsleyi*, *T. par*, *T. taeniola*, *T. williamsi* (one specimen), *Culex decens*, *C. duttoni*, *C. tigripes* var. *fuscus*, *Culiciomyia nebulosa*, *Eretmopodites leucopus*, *Mansonioides uniformis*, *Stegomyia africana*, *S. apicoargentea*, *S. fasciata*, *S. luteocephala*, *Myzomyia costalis*, *M. funesta*, *Culicoides grahami*, and *Ctenocephalus canis*. *Cordylobia anthropophaga* and *Auchmeromyia luteola* have also been recorded from this station, while *Haemaphysalis leachi* was found on a pig and *Rhipicephalus sanguineus* on a leopard.

Dr. Wilson, in forwarding specimens of *Glossina palpalis* and *Chrysops silacea*, wrote :—" These two flies are very common in the station. Both were caught in the dispensary. The *Chrysops* is a vicious biter."

Dr. Macdonald has also kindly supplied the following notes :—

" Sand-flies (*Culicoides grahami*) are a very great pest in this station and bite severely from 4.30 p.m. until dark. They also bite in the morning, but the number then is very small compared with that at evening-time. After one has bitten a well marked wheal is left, which itches intensely for a few minutes, and sometimes the itching lasts for several hours, though of course less severe than that of the first few minutes after the bite. In April they first became troublesome and are at their height now (August). There is a small spring, about 200 yards from the bungalow, and from about 4.30 p.m. they are very troublesome there. They are not so numerous at the bungalow, but still extremely troublesome, about 10–15 settling on one in five minutes. Clearing and drainage of the land around the bungalow seems to have had no effect in the reduction of numbers. The native name for them is " Atita." One European who lived here was perfectly indifferent to them and they caused him no annoyance whatever."

Goats, sheep and pigs seem to thrive quite well at Bende, but horses all die soon after importation. Leopard, bush-cow and several varieties of antelope are to be found in the vicinity of the station.

From Ikpe, about 20 miles from Bende, *Chrysops silacea*, *Hippocentrum trimaculatum*, *Culex duttoni* and *Mansonioides uniformis* have been recorded.

(4) Abakaliki, Ogoja and Obudu.

These three districts have only very recently been opened up, and practically nothing is known either of the physical features of the country or its fauna. According to the official report for 1910 the country is for the most part covered with grass and small trees; there is very little bush, and that only along the rivers and streams. Cattle, sheep and goats are to be found in fair numbers. Horses are often brought in from the north and north-west but inevitably die in the wet season. Elephant are said to be plentiful in the north, while leopard, bush-cow, kob, and duiker are fairly abundant. The district of Obudu has been in the hands of the Civil Authorities only since the end of 1909.

Ogoja.—"The district is divided by the Auja River; that part of the district on the left bank of the river is broken and hilly in parts. There are patches of thick bush, chiefly on the river and creek banks; the remainder is grass country covered lightly with short stunted trees. This part of the district has numerous permanent streams running through it. In parts the country is very stony, chiefly ironstone and hard sandstone, with grey granite in the eastern part of the district. On the right bank of the Auja River, the type of country is totally different from that on the left, it being for the most part open, level, grass country, the only bush being that around the towns, and a little on the banks of the river and streams. Although the country is so flat, it is well watered by permanent running rivers, the largest being the Onwu. The grass in the wet season grows very high.

"The live-stock are cattle (a small breed), sheep, goats, swine, dogs, fowls and ducks. Horses are reported to be bred in the Munshi country, 15 miles north-east of Ogoja. The few horses already brought into the district appear to do well, although the tsetse-fly is very prevalent.

"Wild animals are plentiful, viz.:—bush-cow, hippopotami, water-buck, cob, crocodiles, porcupines, a large variety of small antelope, hares, leopards, and civet cats. Elephants and rhinoceros are reported to be in large numbers to the east of Ogoja, about 25 miles distant, which forest is said to be teeming with big game of all sorts."

Mr. M. H. Corsellis, the District Commissioner at Ogoja, writing in November 1910, said that both *G. palpalis* and *G. morsitans* had been found in the district. He also added that both horses and dogs had died of trypanosomiasis and that trypanosomes had been found in the blood of these by the District Medical Officer.

(5) The Cross River.

Ikom.—The country to the north and north-east of this district is well-watered and covered with dense forest; to the west it is undulating and covered with grass; to the south and south-east it is hilly with numerous farms in the valleys. The whole country abounds in game. Elephant, leopard, bush-cow, water-buck and kob are very common, while in the river hippopotami, manatee and crocodiles are plentiful.

During my stay at Ikom I saw many trees, especially "Flame of the Forest" (*Flamboyia regia*), damaged by the larvae of beetles. These species have been identified as *Coptops fusca* (Fam. LAMIIDAE) and *Lagria sp.* (Fam. LAGRIIDAE).

In addition to the species of blood-sucking flies obtained by the writer, Dr. W. S. Clark and Mr. E. Dayrell have sent a number of species, and the following list has been compiled from these sources. At Obokum on the Cross River, near the German frontier, *Tabanus besti*, *T. marmorosus*, *T. obscurehirtus*, *T. ruficrus* and *T. secedens* are common; while from Ikom station the following species have been recorded:—*Glossina palpalis*. *G. fusca*, *G. tabaniformis*, *G. tachinoides*, *Subpangonia grahami*, sp. n. (see p.), *Tabanus fasciatus*, *T. obscurissimus*, *T. ruficrus*, *T. taeniola*, *Chrysops silacea*, *Haematopota cordigera*, *Hippocentrum trimaculatum*, *Mansonioides uniformis* and *Myzomyia costalis*. *Rhipicephalus sanguineus* is very common on the cattle, sheep, goats and dogs.

I traversed the whole of the Cross River from Ikom to Calabar by launch and obtained an enormous number of biting flies by this means. The accompanying photographs (Pl. IV, fig. 2 and Pl. V) will serve to give some idea of the nature of the banks of this river during the dry season. In the rainy season the level of the river ascends to the top of the banks, a distance of over forty feet in some places where the river is narrow (Pl. V, fig. 2).

The portion of the river between Ikom and Obubra was undoubtedly the worst haunt of *Glossina palpalis* seen by me in Southern Nigeria, and is comparable only with the Bintang Creek in the Gambia.* Besides this species the following were also abundant:—*Tabanus fasciatus*, *T. ruficrus*, *T. taeniola* and *T. combustus*.

Obubra.—Southwards from Ikom is the district of Obubra. It is very hilly and full of deep ravines, stony in places, but fertile, except in the Ikwe country, which is very swampy. Cattle, sheep and goats are kept by the natives, and a few horses exist near the northern boundary. The game is very similar to that at Ikom. In and around the station of Obubra the following species of blood-sucking flies have been caught:—*Tabanus fasciatus*, *Subpangonia gravoti*, *Haematopota cordigera*, *Mansonioides uniformis*, *Myzomyia funesta* and *M. costalis*. *Rhipicephalus sanguineus* is very troublesome to cattle, sheep and goats. Between Obubra and Afikpo the following species were caught on board the steamer:—*Glossina palpalis*, *Tabanus fasciatus*, *T. secedens*, *T. taeniola* and *T. thoracinus*, while near Ediba Beach *Tabanus combustus* and *T. besti* were obtained.

Afikpo.—The district of Afikpo is situated on both banks of the Cross River. On the left bank the country is thickly forested, but on the right it is open, grassy and very undulating, gradually merging into the rolling grassy plains and hills of Okigwi. On the road from Okigwi to Afikpo, *Glossina palpalis* was caught at the Iziarka River; between this river and the town of Eke-Ada the same species was encountered along with *Hippocentrum trimaculatum*, while between Eke-Ada and Afikpo only the latter species was seen.

The station of Afikpo is situated on a high hill over a mile from the river. At the base of this hill there is a large swamp which is a powerful local fetish. This swamp is a pestilential breeding-place for mosquitos. Some difficulty has

* Bull. Ent. Res. II, pt. 3, p. 209.

been experienced by the authorities in having this area drained or filled in, and the native feeling is so strong that for the present the idea has to be abandoned. It is to be hoped, however, that soon this prejudice will be overcome, to the lasting good of the European quarter. This station has the unenviable reputation of being almost, if not quite, the most unhealthy in Southern Nigeria. The present situation of the European bungalows is in the direct line of the prevailing wind which blows over the swamp mentioned. The bungalows are continually infested with mosquitos, and the following species are extremely abundant:—*Myzomyia funesta*, *M. costalis*, *Mansonioides uniformis*, *Culex grahami* and *Culiciomyia nebulosa*.

On the steamer between Afikpo and Itu numerous specimens of the following species of blood-sucking flies were obtained:—*Glossina palpalis*, *Tabanus fasciatus*, *T. secedens*, *T. socialis*, *T. taeniola* and *T. thoracinus*. At the town of Itu *Chrysops silacea*, *Tabanus secedens* and *Glossina palpalis* have been caught.

Aro-Chuku.—Nearly the whole of this district is undulating and broken, and a large part of it is under water during the wet season. On the right bank of the river the bush is thin and there is a fair amount of cultivation, but on the left the bush is much more dense and the country is practically uninhabited. Goats are almost the only domestic animals kept, and game is scarce.

Uyo.—South of Aro-Chuku is the district of Uyo. The centre is flat, the east is hilly, but towards the west the country is open and extensively cultivated. The bush contains many oil-palms; it is very thick on the banks of the river and creeks and in the west and south-west portions of the district. There are no horses and cattle; sheep and goats are scarce; none of them are bred systematically. Hippopotami and crocodiles are to be found in the river, but inland there are only a few harnessed antelope, leopard, pig, wild cats and monkeys.

From Odut on the left bank of the river *Tabanus subangustus* and *T. obscure-fumatus* have been recorded.

Calabar.—The whole district is hilly, but there are no very marked ranges. The country is densely covered with forest, thickest in the north-west near Uwet, and least in the north-east or Akpaboyo country, where there is a considerable amount of cultivation. In the southern part, towards the German frontier and the sea, there is an extensive mangrove belt intersected by numerous creeks.

The town of Calabar is large and important; it is the headquarters of the Eastern Province and a busy seaport. The only Tabanids actually seen within the precincts of the town were *T. socialis* and *Chrysops silacea*, and though the number of different species of mosquitos was comparatively large, the actual number of individuals was far from excessive—a fact which says much for the systematic prophylactic measures inaugurated by the Senior Medical Officer. The following species were obtained:—*Myzomyia costalis*, *Culex insignis*, *C. rima*, *Culiciomyia nebulosa*, *Ochlerotatus domesticus* and *Hodgesia sanguinis*. The occurrence of the last-named species is remarkable, as, prior to this, the only other locality from which it has been recorded is Entebbe, the capital of Uganda.

Glossina palpalis is frequently met with in Calabar; this is due in great part to the large amount of dense bush on the face of the cliff separating the town from the river. Dr. Chichester has time and again condemned this and urged its removal, and it is to be hoped that soon this will be accomplished.

Capt. Rojas of the Southern Nigeria Marine captured several specimens of *Tabanus secedens* and *T. fasciatus* during a trip up the Calabar River to Uwet, and informed me that both these species are everywhere abundant on the river. *Tabanus combustus* has also been recorded from Uwet.

During my visit to this region, I had an opportunity of examining both the Henshaw Creek, which joins Calabar and the Kwa River, and also the Ikang Creek, which leads through to the German frontier. Both these creeks are very narrow, in fact, it is difficult for a small launch to turn in either of them; the ground is muddy and the vegetation is dense; the air is musty and damp; and altogether they are pestilential passages. In Henshaw Creek *Tabanus secedens*, *T. besti*, and *Glossina palpalis* were a source of great annoyance, while during the day in the Ikang Creek the same three species, together with *Glossina caliginea*, kept one continually on the alert. It was my misfortune to have to anchor in the latter creek over-night, and never did I see such swarms of mosquitos (*Myzomyia costalis*). From five o'clock onwards, these attacked unrelentingly, and as the launch was small, it was impossible to have one's bed put up early. Consequently, every attempt to do so and at the same time exclude mosquitos ended in absolute failure. It is no exaggeration to say that there were thousands of these in the small cabin persistently throughout the whole night. The fact also that an anchor-light was essential attracted more and more, and the native sailors, who are generally oblivious to a reasonable number, spent the whole night, like the writer, moving about and trying, though unsuccessfully, to reduce the number of voracious onslaughts.

The following are some further records of blood-sucking insects from the Cross River area :—

At the mouth of the river—*Tabanus obscurehirtus*.

Stubbs Creek—*Tabanus socialis* and *Chrysops silacea*.

Awa Creek—*Chrysops silacea*.

At Ndogolai—*Chrysops dimidiata*.

Dr. R. W. Gray has also sent specimens of *Culicoides grahami*, *Phlebotomus duboscqi* and *Simulium damnosum*, from the Cross River region, but without any definite data or localities.

(6) Oban.

This district lies to the east of the Cross River, at the foot of the Kamerun mountains. In physical characteristics it is quite different from any other region in Southern Nigeria, and on this account, and also from the fact that it is the meeting-place of the great Congo Forest with the belt which stretches up the West Coast, the fauna is peculiarly interesting and would well repay investigation.

Unfortunately, the writer was unable to visit this region during his tour in Southern Nigeria, but the following description is based on the official report for that colony, while, for the few insect records, we are indebted to Mr. J. H. J. Farquhar, Provincial Conservator of Forests in the Colony.

"The district is a mass of hills, interspersed with valleys, ravines and rivers. Everywhere loom up the granites, schists and gneisses of the ancient Oban rocks, rising 3,000 feet high, some of them extraordinarily picturesque and grand for their size. Except to the south of Oban there is hardly a level spot. The main water-shed stretches across the country from east to west at about the latitude of 5° 30′, north of which the streams flow into the Cross River, and to the south combine to form the Calabar, Kwa and Akwayafe Rivers. Many of the largest rivers rise on opposite sides of the same hill, such as the Calabar and the Kwa, the Akwayafe and the Akarram. None are navigable within the district except the lower reaches of the Kwa. With the exception of the village clearings and a few farms, hidden away here and there, the country is covered with dense forest—the Ekoi Forest.

"The rainy season lasts from May to November, and the annual rainfall is exceptionally heavy, probably well over 150 inches. Travelling in the northern parts is arduous owing to the rocky ground and to the fact that the paths go up and down over hills 1,000 and 2,000 feet high.

"Hunting is the chief occupation of the people. The men are splendid hunters and many of them devote all their time to the chase. Each town has its own special part of the bush reserved for its inhabitants."

The district abounds in game of all kinds. Elephants roam about in large herds, especially in the rainy season, generally retiring to the Kameruns in the dry season. Lions are said by the natives to come sometimes down as far south as this in pursuit of game; leopards are everywhere. The forest is full of bush-cow, water-buffalos, wild pig, many kinds of antelope, such as the harnessed antelope, the smaller bush-buck, the black-backed and yellow-backed duiker, baboons, etc., etc. Malaria, elephantiasis, and dysentery are very common. The only blood-sucking insects so far recorded from this region are *Chrysops silacea*, *Tabanus fasciatus*, *T. obscurefumatus*, *Glossina fusca* and *G. tabaniformis*, in addition to a new species of *Tabanus* not yet described; but this is undoubtedly far short of the actual number.

A systematic examination of this region would certainly reveal many rare species, in fact, from the five recorded above, one, *T. obscurefumatus*, has not been recorded from elsewhere in Southern Nigeria, while the only other locality in which *G. tabaniformis* has been found is Ikom, which is part of the same topographical unit. Here we might expect to find an intermingling of the true Congo forms with the undoubted Coast forms.

IV. Records of Blood-sucking Insects and other Arthropods from Southern Nigeria.

The records of the various blood-sucking insects and ticks found in Southern Nigeria have been detailed in the preceding pages in connection with the different regions discussed. At the same time it is considered advisable to tabulate these in their orders and families, as hitherto no complete list has been attempted. It will be seen from this list that our knowledge of the species of this region has considerably increased, even since the publication of Austen's "African Blood-Sucking Flies" in 1909, while a study of the narrative in this report will serve to show the enormous advance made in our knowledge of the distribution of the various species.

It must not be supposed that this list by any means exhausts the species to be found in Southern Nigeria; in fact several forms at present await description and undoubtedly many more will be found, especially perhaps in the north and east of the Eastern Province. Further, it must be noted that much has yet to be learnt as regards the distribution of all the species here recorded; in fact, in most cases the records are so scanty that it would be inadvisable to enter into any discussion as to their general distribution. It is to be hoped, therefore, that this list may be taken only as a guide as to what has been accomplished and that the narrative may help to show how inadequate our information is, and so stimulate others to collect even the most common species from every available locality, in order that eventually we may be able to map out the distribution of each.

Order DIPTERA.

Family Culicidae.

Aëdomyia catastica, Knab.
Banksinella luteolateralis, Theo.
Culex annulioris, Theo.
„ *consimilis*, Newst.
„ *decens*, Theo.
„ *duttoni*, Theo.
„ *grahami*, Theo.
„ *guiarti*, Blanch.
„ *insignis*, Carter.
„ *invidiosus*, Theo.
„ *ornatothoracis*, Theo.
„ *pruina*, Theo.
„ *quasigelidus*, Theo.
„ *rima*, Theo.
„ *thalassius*, Theo.
„ *tigripes*, Gr. var. *fuscus*, Theo.
„ *univittatus*, Theo.
„ *zombaensis*, Theo.
Culiciomyia nebulosa, Theo.
Eretmopodites inornatus, Newst.
„ *leucopus*, Graham.
„ *quinquevittatus*, Theo.
Hodgesia sanguinis, Theo.
Ingramia nigra, Theo.
„ *uniformis*, Theo.
Mansonioides uniformis, Theo.
Micraëdes inconspicuosus, Theo.
Mimomyia mimomyiaformis, Newst.
„ *plumosa*, Theo.
Mucidus mucidus, Karsch.
Myzomyia costalis, Loew.
Myzomyia funesta, Giles.
„ *marshalli*, Theo.
„ *pitchfordi*, Power.
„ *nili*, Theo.
Myzorhynchus mauritianus, Gr.
„ *paludis*, Theo.
„ *umbrosus*, Theo.
Nyssorhynchus pharoensis, Theo.
Ochlerotatus caliginosus, Grah.
„ *domesticus*, Theo.
„ *irritans*, Theo.
„ *longipalpis*, Grünb.
„ *marshalli*, Theo.
„ *nigeriensis*, Theo.
„ *nigricephalus*, Theo.
„ *punctothoracis*, Theo.
Stegomyia africana, Theo.
„ *apicoargentea*, Theo.
„ *fasciata*, F.
„ *luteocephala*, Newst.
„ *sugens*, Wied.
Taeniorhynchus annetti, Theo.
„ *aurites*, Theo.
„ *cristatus*, Theo.
„ *metallicus*, Theo.
Toxorhynchites brevipalpis, Theo.
Uranotaenia annulata, Theo.
„ *balfouri*, Theo.
„ *coeruleocephala*, Theo.
„ *mashonaensis*, Theo.
„ *mayeri*, Edw.

Family Tabanidae.

Chrysops dimidiata, Wulp.
„ *longicornis*, Macq.
„ *silacea*, Aust.
Haematopota cordigera, Bigot.
„ *decora*, Walk.
„ *tenuicrus*, Aust.
Hippocentrum trimaculatum, Newst.
„ *versicolor*, Aust.
Rhinomyza stimulans, Aust.
Subpangonia gravoti, Surc.
„ *grahami*, Aust.
Tabanus argenteus, Surc.

Family Tabanidae—*cont.*

Tabanus besti, Surc.
„ *biguttatus*, Wied. var. *croceus*, Surc.
„ *billingtoni*, Newst.
„ *combustus*, Big.
„ *ditaeniatus*, Macq.
„ *fasciatus*, F.
„ *kingsleyi*, Ric.
„ *laverani*, Surc.
„ *marmorosus*, Surc.
„ *obscurefumatus*, Surc.
„ *obscurehirtus*, Ric.
Tabanus par, Walk.
„ *pluto*, Walk.
„ *quadrisignatus*, Ric.
„ *ruficrus*, P. de B.
„ *secedens*, Walk.
„ *socialis*, Walk.
„ *subangustus*, Ric.
„ *taeniola*, P. de B.
„ *thoracinus*, P. de B.
„ *williamsi*, Aust.
Thaumastocera akwa, Grünb.

Family Muscidae.

Auchmeromyia luteola, F.
Cordylobia anthropophaga, Grünb.
Glossina caliginea, Aust.
„ *fusca*, Walk.
„ *longipalpis*. Wied.
„ *medicorum*, Aust.
„ *nigrofusca*, Newst.
„ *pallicera*, Bigot.
Glossina palpalis, Rob. Desv.
„ *tabaniformis*, Westw.
„ *tachinoides*, Westw.
Stomoxys brunnipes, Grünb.
„ *calcitrans*, L.
„ *nigra*, Macq.
„ *omega*, Newst.

Family Chironomidae.

Culicoides distinctipennis, Aust.
„ *grahami*, Aust.
„ *milnei*, Aust.
Ceratopogon castaneus, Walk.
„ *inornatipennis*, Aust.

Family Simuliidae.

Simulium damnosum, Theo.

Family Psychodidae.

Phlebotomus duboscqi, Nev.-Lem.

Family Hippoboscidae.

Hippobosca maculata, Leach.

Order SIPHONAPTERA.

Family Pulicidae.

Ctenocephalus canis, Curtis.
Xenopsylla brasiliensis, Baker.
Xenopsylla cheopis, Roths.

Family Sarcopsyllidae.

Dermatophilus penetrans, L.
Echidnophaga gallinacea, Westw.

Order ANOPLURA.

Family Haematopinidae.

Linognathus africanus, Kell. & Paine.

Order RHYNCHOTA.

Family Cimicidae.

Cimex rotundatus, Sign.

Order ACARI.

Family Ixodidae.

Amblyomma nuttalli, Dön.
„ *variegatum*, F.
Boophilus decoloratus, Koch.
Haemaphysalis leachi, Aud.
„ *parmata*, Neum.
Hyalomma aegyptium, L.
Rhipicephalus neavei, Warb.
„ *sanguineus*, Latr.
„ *simpsoni*, Nutt.
„ *simus*, Koch.
„ *sulcatus*, Neum.

V.—Insect-borne Diseases in Man and other Animals.

Malaria.

As in all West African Colonies, malaria is by far the most prevalent insect-borne protozoal disease, but owing to the free use of quinine and prophylactic measures, such as the adoption of mosquito-nets and mosquito-proof rooms, and also more sanitary conditions, which tend to reduce the number of mosquitos, this disease does not now account for nearly so many invalidings and deaths as formerly. In spite of the length of time since the connection between Anopheline mosquitos and malaria was established, it is surprising how little is still known of the actual species which are implicated in its transmission in Africa. A fruitful line of research, and one by no means difficult to accomplish, would be the wholesale dissection of the various species of Anophelines found in each and every district, in order to ascertain which species, and what percentage of specimens, contain sporozoits of the malaria parasite.

Yellow fever.

There is still some difference of opinion as to whether this disease is actually endemic in West Africa, but that it does exist in that region there is now no doubt, and further, it is becoming more and more evident that it has a strong hold. The number of cases among the native population is very small, but among Europeans it is relatively very heavy. Southern Nigeria has not suffered so much as the Gold Coast, Sierra Leone and the Gambia, but two cases occurred in Lagos in July and September, 1910, in which the symptoms were strongly indicative of this disease. The degree of immunity of the natives is still a matter under discussion, and whether the children harbour the parasite, as in the case of malaria, is absolutely unknown. It has been shown, but not in West Africa, that this disease is transmitted by *Stegomyia fasciata*, but there is no evidence to justify our supposing that this is the only transmitting agent. In another section I have discussed briefly the distribution of *Stegomyia* in Southern Nigeria.

With the continual intercourse of natives between the various West African colonies, there is a constant risk of this disease spreading, and it may be that many natives harbour the parasite without themselves showing any symptoms of the disease ; if so, the risk to Europeans is very much greater. Since it is known that the disease is transmitted by *Stegomyia fasciata*, and that this species is so common all along the coast, and when the number of European deaths from this cause during the past year is recalled, it is surely not too much to say that every effort should be made to diminish the number of mosquitos. It is gratifying to note that the Government of Southern Nigeria has not been behind in this work, and that recently a quarantine station has been erected in one of the side creeks near Forcados, away from the beaten track.

Sleeping Sickness.

This disease seems to be far from common in Southern Nigeria. Several doubtful cases in natives have been recorded, but not within recent times has

there been anything like an epidemic. One European, however, contracted this disease in the Cross River region. It might be well to remember, however, that, should any cases be found and it be considered necessary to isolate them, no region could be more favourable for such a camp than in the northern part of the Western Province near Shaki, because from this region no *G. palpalis* has been recorded nor is it likely that it exists there.

Elephantiasis.

This malady is not infrequent in the Colony, but what insect or insects are implicated in its transmission is entirely unknown.

Calabar Swelling.

This disease was first described from Southern Nigeria and, though not fatal, causes very great suffering. Several Europeans, especially those in the coast region, have become infected, but by what species of insect is as yet unknown.

Trypanosomiasis of Stock.

This is everywhere to be found. Except in a very few places, and then only by careful supervision, is it possible to keep horses in Southern Nigeria ; sooner or later they succumb. Cattle do not die off so quickly, but it is hardly possible to find an animal not infected with trypanosomes. The mortality from the disease itself is practically nil, as the natives kill and eat all animals as soon as they show very advanced symptoms. Interesting in this connection is the fact that in a very few districts there is a small breed of cattle, mentioned elsewhere in the report, which is said to be immune to this disease.

Piroplasmosis.

This disease, so far as I could learn, is almost entirely confined to dogs.

Plague.

Though occurring both sporadically and in endemic form in the Gold Coast, plague has not yet been recorded from Southern Nigeria. It is interesting to note, however, that the writer obtained a plague flea (*Xenopsylla cheopis*) from a rat (*Mus rattus*) captured at Lagos. This fact should not be overlooked, and it is desirable that measures for the wholesale destruction of rats should be encouraged, because, in the event of the disease being once introduced, there is reason to believe that the factors exist for its distribution.

VI.—The Distribution of Glossina.

Altogether nine species of *Glossina* have been recorded from Southern Nigeria, the largest number found in any one British colony. These belong to all the four groups described by Austen in his " Handbook of the Tsetse Flies." The following notes will serve to illustrate the main points in the distribution of the various species, though it must be remembered that the records at present available are far from exhaustive. The accompanying map will show in a more concrete form the general trend of the distribution.

(*a*) G. palpalis-group.

Belonging to this group there are no fewer than four species found in Southern Nigeria. By far the most widely distributed of these is *G. palpalis*, which may be said to follow all the different river systems. This, however, is not surprising when it is remembered that, no matter how widely separated are the origins of these river systems, they are all linked up along the coast region by a series of lagoons and creeks. In the Western Province this species has been found on the Yewa River, and probably extends to Meko and beyond. It also occurs in the lagoons near Lagos, at Agege, and further north on the Ogun River near Aro. Further east, it has been recorded from the basin of the Oshun River, at Oshogbo, while in the same system it has been found between the Oshun and the Oni Rivers, at Ilesha and elsewhere in this district, and also on the Oni River itself. It may be said to be ubiquitous in the Niger system and especially abundant in the delta—while extreme records in this area are Benin City and Agbor. It is also found in the basin of the Imo, for example at Bende and between Okigwi and Afikpo ; moreover it is everywhere abundant in the Cross River area.

It is interesting to note that in the Niger delta region the specimens belonging to this species, as at present known, are rather darker and larger than the typical forms, while these diminish in size and become much paler in colour north of Aboh and Onitsha.

Glossina tachinoides has been recorded from only two places in Southern Nigeria, namely, Ikom and Bende. It is extremely common in Northern Nigeria, and the record from Ikom is not surprising, but its occurrence at Bende would seem to indicate that it may be found more commonly in the Cross River basin than is supposed.

Glossina caligineu. This species, only recently described, has been recorded from comparatively few places, but these are so widely separated that it will probably be found to occur along the whole of the coast belt. As will be seen from the map, it occurs on the Yewa River, Oni River, Niger Delta, Kwa-Ibo River and the Cross River. So far, this species has been found only in this Colony. Nothing is known of its habits or life-history beyond the fact that it is a ferocious biter.

Glossina pallicera is one of the rarest of the West African species of *Glossina.* A single specimen taken by the writer at Benin City, in March, 1910, is so far the only record from this Colony.

(*b*) G. morsitans-group.

Of this group only one species, *G. longipalpis*, is known from Southern Nigeria. Although *G. submorsitans* is very common in Northern Nigeria, it is not found so far south as this Colony, but if the Shaki district were examined, it is possible that it would be found there.

G. longipalpis is known to occur in Southern Nigeria, in the drier parts of the northern districts of the Western Province, and also in similar situations in the Central Province.

(*c*) G. fusca-group.

Three species belonging to this group are represented in Southern Nigeria. The only other species so far attributed to this group is *G. fuscipleuris*, of which only the type specimen, from the Congo Free State, is known.

Glossina fusca is most common in the hilly regions of Ilesha and Oban, but has also been found on the Yewa River and at Bende, while a single specimen was taken by the writer at Yaba, near Lagos. This species has been recorded only once from Northern Nigeria, and that from the Kabba Province, which borders on Southern Nigeria.

Glossina nigrofusca has been found only on the Oni River, but, as in the case of *G. caliginea*, its distribution probably extends along the lagoon-delta area.

Glossina tabaniformis has been recorded from only two localities in Southern Nigeria, namely, Ikom and Oban, both in the Cross River basin and at the foot of the Kameruns.

(*d*) G. brevipalpis-group.

The only species belonging to this group which occurs on the West Coast is *G. medicorum ;* it has been recorded only once from Southern Nigeria, namely, from Asaba. The other two species, *G. brevipalpis* and *G. longipennis*, are peculiarly East African forms.

These few notes refer particularly to the distribution of the various species in Southern Nigeria, but I should like here to add some remarks on the general distribution of some of these species in Nigeria as a whole. For this purpose the general physical configuration, the nature of the vegetation, and the character of the climate and rainfall must be taken into account. The main characteristics of each of these have been given in some detail in this and a previous report, so that it is necessary here only to refer to the more prominent features.

Nowhere in this area are there any very prominent mountains, and, as those ranges which exist are important only in so far as they constitute the various watersheds, they may be considered in a very general way. The most important of these is the Bauchi Plateau, which separates the Niger-Benue river system in Northern Nigeria from the Lake Chad system. Next, there is a spur of the Kameruns, which abuts the boundary of Northern and Southern Nigeria and separates the Benue system from that of the Cross River. In the north-west of Southern Nigeria, there is a small range of hills which divides the Niger from the series of small rivers in the Western Province of Southern Nigeria, while this same range, continuing southwards and eastwards, forms the western limit of the Niger system.

Thus it will be seen that there are four separate river systems. By far the largest and most important is the Niger-Benue system, which drains nearly half of Southern Nigeria and almost three-quarters of Northern. In Southern Nigeria there is also the Cross River system in the Eastern Province and a series of small rivers in the Western, while in the north-east corner of Northern Nigeria there is the system of rivers which drain into Lake Chad. It has been noted elsewhere in this report that along the coast region of Southern Nigeria all the rivers in that colony are united by a series of creeks and lagoons. Consequently,

their insect faunas must constantly intermingle, and it would be surprising if they were distinct. The Lake Chad system is therefore the only one which can be considered as topographically distinct from the others.

It is extremely difficult to express in general terms the distribution of the various types of vegetation in this area, but in the coast region the mangrove holds exclusive sway, while in Southern Nigeria and the southern parts of Northern Nigeria the fresh-water swamp forest is predominant, especially in the valleys of the rivers. Further removed from the larger streams, there is a certain amount of mixed deciduous forest, while in the north of Northern Nigeria the savannah forest, and ultimately almost pure savannah, is found.

In the south of Southern Nigeria the climate is equatorial, *i.e.*, there is no true separation of dry and wet seasons; in the northern districts, and in the south of Northern Nigeria, there is a transition stage between this form and the true tropical form, in which the dry and wet seasons are perfectly distinct and of almost equal duration. Details of these forms have already been given in these reports.

How far, then, is the distribution of *Glossina* correlated with these phenomena? The species to which I would draw attention here are:—*G. palpalis* and *G. tachinoides* in the *palpalis*-group; *G. submorsitans* and *G. longipalpis* in the *morsitans*-group; and *G. fusca* in the *fusca*-group.

Of these by far the most widely distributed is *G. palpalis*. This species is ubiquitous along the coast region and follows the course of all the rivers. It is especially abundant in the delta area and is found at all parts of the Niger within British territory. In the smaller rivers in the Western Province of Southern Nigeria it is found at considerable distances from the coast, while it is the prevalent species throughout the Cross River, at any rate up to the point where this river enters German territory.

On the Benue River it has not been found further up than Loko, a station not far from Lokoja. Consequently, this species exists wherever the rainfall is great, where the dry season is not of long duration, where the vegetation is dense, and always along the basins of rivers. Where any or all of these factors are less accentuated, the number of individuals tends to decrease, for example, in the higher reaches of the River Niger and on the Benue.

The conditions which are most favourable for *G. palpalis* are, generally speaking, most unfavourable for *G. tachinoides*. Where the country is open, the vegetation sparse, the dry season well defined and the rainfall slight, there *G. tachinoides* is most abundant. Consequently, this species is the predominant one in the region bordering the Sahara in Northern Nigeria; it is the only member of the *palpalis*-group found in the Lake Chad area.

We may therefore consider the dispersion of *G. palpalis* as coming from the south and of *G. tachinoides* from the north, so that in the intermediate region both species occur, and, according as to which of the two sets of conditions already mentioned is most marked, there will be a preponderance in the number of individuals of one or other of the species. A comparison of the map which accompanies this report with that given for Northern Nigeria will show that this is precisely what occurs.

Only two species belonging to the *morsitans*-group occur in this area, namely, *G. submorsitans* and *G. longipalpis*. The former is confined entirely to Northern Nigeria, while the latter, though fairly abundant in Southern Nigeria, is very scarce in Northern Nigeria and is found only in the southern portion. Neither of these species is so intimately associated with the rivers as *G. palpalis*, but they are found in the more open country. Broadly speaking, *G. submorsitans* inhabits the drier regions where the savannah forest is predominant, being, consequently, similar in habits to *G. tachinoides*; while *G. longipalpis* is associated with a moister climate and a slightly denser vegetation of the mixed deciduous forest type.

The distribution of *G. fusca* is almost coterminous with that of *G. longipalpis* and its habitats are similar. It favours dense vegetation and a moderately moist climate.

I hope in a future paper to deal at greater length with the distribution of not only *Glossina*, but also the various species of TABANIDAE and CULICIDAE, but these few notes may serve to show along what lines the factors influencing distribution may be sought.

One thing at least is evident from a study of the distribution of the various species of *Glossina*, namely, that cattle and horse trypanosomiasis in Nigeria is not associated with one and only one species. This disease is prevalent in the Lake Chad area, where only *tachinoides* and *submorsitans* are found, while it is equally prevalent in the western province of Southern Nigeria, where *palpalis* and *longipalpis* are the predominant species.

In my report on the Gambia* I added a few notes on the bionomics of *Glossina*, and as these are equally applicable to Southern Nigeria, there is little necessity for again recording them. Further, throughout the present report I have added whatever seemed important as to prevalence, nature of habitat, &c., of *Glossina palpalis*, but I should like to draw attention to our scanty knowledge of the bionomics and life-histories of the other and rarer species.

VII.—The Distribution of Stegomyia.

In view of the connection between this genus of mosquitos and yellow fever, it has been considered advisable to recall briefly what is known as to its prevalence in Southern Nigeria. Two papers have recently appeared in this Bulletin bearing upon this question, so that I do not propose to deal with it at any length. The first of these papers was by the late Sir Rubert Boyce,† in which he drew attention to the prevalence of yellow fever in West Africa and afterwards to the high percentage of *Stegomyia fasciata* mosquitos in the coast towns. The second was written by Dr. W. M. Graham,‡ and gave the results obtained from a monthly examination of native domestic water-receptacles at Lagos in 1910–11. The total number of receptacles examined was 1,043 and in 965 of these, *i.e.*, 92·5 per cent., larvae of *Stegomyia fasciata* were obtained. He proceeds to say: "It is the commonest species of larva, is widely distributed over the township

* Bull. Ent. Res. II, pt. 3, pp. 187–239.
† Bull. Ent. Res. I, pt. 4, pp. 233–263.
‡ Bull. Ent. Res. II, pt. 2, pp. 127–136.

and is found in all varieties of water-vessels. It is hardy and not much affected by environment, living in both clean and foul water with equal facility. Its chief natural enemy in these water-receptacles is the large carnivorous larva of *Culex tigripes* var. *fusca*, Theo."

In all, five species of this genus have been recorded from Southern Nigeria, and it might be well to review the distribution of each of these. By far the commonest, both as regards individuals in any one locality, and also in general distribution, is *S. fasciata*, but it is far from probable that the records here given are by any means exhaustive for the Colony. So far as can be judged at present, this species is most abundant in the Niger delta region. It has been found at Sapele, Warri, Forcados, Burutu, Brass, Akassa, Bonny, Opobo and Degema, and may be said to be ubiquitous in this area. It is almost impossible from a mere examination of specimens sent in by collectors to form any reliable estimate of the relative abundance of the species as compared with the total mosquito population, for collections made at different times of the day give different results and a great deal also depends on the situations in which the mosquitos have been caught.

In the Western Province, *S. fasciata* has been recorded from Lagos, Yaba, Oshogbo and Ilesha, while in the Eastern Province it has been caught at Calabar, Ikot-Ekpene and Bende. It should be noted, however, that at all these places considerable collecting has been done, and this may account for the apparent gaps in the distribution, and it will probably be found, when the fauna of other regions is better known, that it occurs all over the Colony. It has recently been taken at Maidugari, near Lake Chad, in N. Nigeria, and at Geidam, on the edge of the Sahara, where the climate and other conditions are extremely divergent from those in, for example, the Niger delta.

Stegomyia africana has been found at Lagos, Yaba, Oshogbo, Forcados and Bende ; *Stegomyia apicoargentea* at Yaba and Bende ; *Stegomyia luteocephala* at Yaba and Bende ; and *Stegomyia sugens* at Oshogbo.

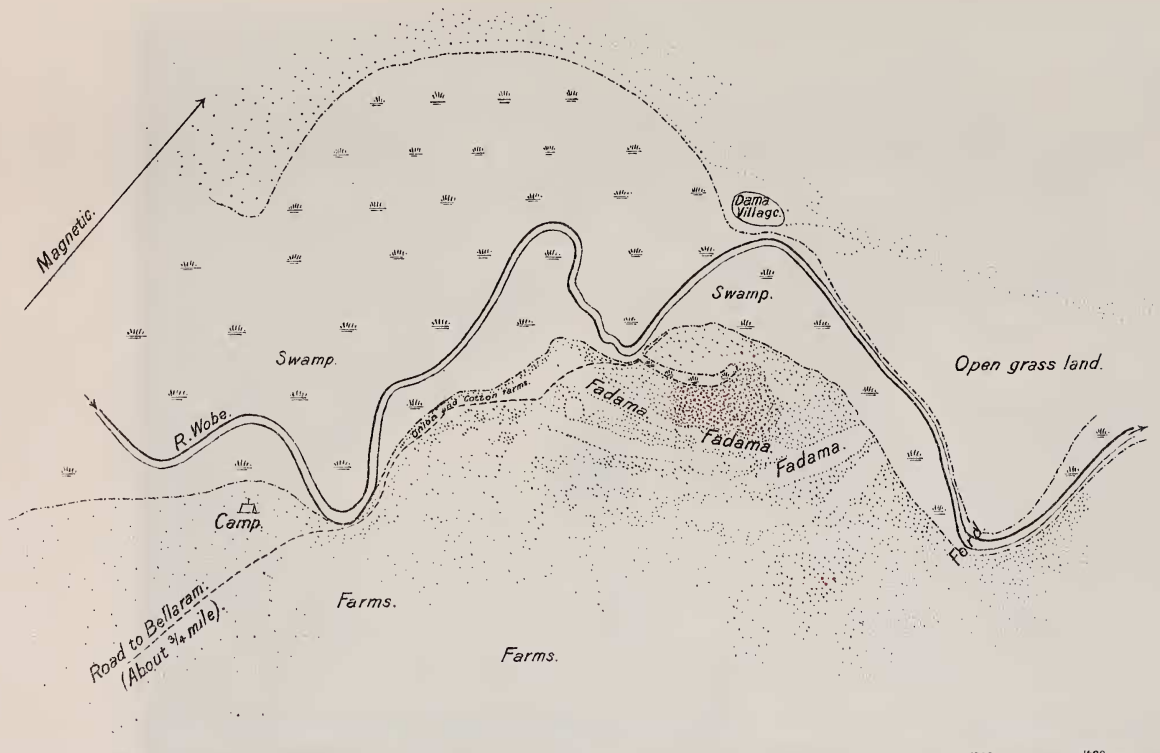
It is probably too sweeping to say that *S. fasciata* is the most common mosquito on the coast, because the records based on large collections of mosquitos made in Southern Nigeria do not altogether bear this out. As has been noted, however, this may in part be due to the method of collecting, and in part to the time and situation chosen for such work.

The danger is, however, none the less minimised by this, and every effort should be made to exterminate the pest. As in the case of other mosquitos, measures should be directed against the larvae. It is now well known that *Stegomyia* is a " small receptacle " breeder and is not commonly found in the vicinity of swamps. All vessels which might retain water ought to be inverted when not in use and stringent efforts should be made to ensure that this is done in native compounds. Further, it ought to be a punishable offence to have within a compound any receptacle containing mosquito larvae of any description. Unfortunately, this offence is not restricted to native quarters, and the servants of Europeans are often offenders in this direction. To supplement this work, European residences should be segregated from native villages. In this connection one might mention that the town of Lagos is the most flagrant example of the intermingling of native and European houses.

In conclusion, I wish to take this opportunity of recording my indebtedness to all those whose names appear in this report, for their kind assistance in furthering the investigation, and at the same time express the hope that this work, so well begun by them, may be continued and may also stimulate others to similar efforts, so that soon our knowledge of (1) the distribution of blood-sucking insects, (2) their habits and habitats, and (3) the diseases with which they may be implicated, may be such as to form a sound basis for thorough-going prophylactic measures, to the everlasting benefit of not only the native population, but also of the many Europeans who are compelled to spend a great part of their lives in this not over-salubrious Colony. Already much has been done in this direction, and the invaliding rate is being reduced annually, but more strenuous efforts will have to be made, based on a fuller knowledge of the underlying causes and principles. This, in turn, is possible only by continued work along the lines indicated in this and similar reports.

Especially, however, would I express my indebtedness to His Excellency the Governor, Sir Walter Egerton, K.C.M.G., than whom no one is more keenly alive to the necessity for this work, for the many ways in which he assisted me during my stay in the Colony, and for his many personal as well as official kindnesses; to Col. H. C. Moorhouse, D.S.O., whose suggestions, based on an intimate knowledge of the Colony, were invaluable in carrying out the work expeditiously; to Dr. W. H. Strachan, C.M.G., the Principal Medical Officer, from whom I received every facility and assistance; to Dr. F. G. Hopkins (now Principal Medical Officer of the Gold Coast), for his kind co-operation and the many ways by which he sought to place the investigation on a sound basis; to Dr. T. F. G. Mayer, whose paper already published in this Bulletin is a permanent record of genuine interest; to Dr. Connal, for his valuable collections and observations and also his personal kindness during my residence at Yaba; to Dr. A. W. S. Smythe, in remembrance of many profitable excursions by launch in tsetse-haunts; to the various Marine and Railway officials whose ready co-operation and assistance were everywhere manifested; and to these and other political and medical officers in whose districts I travelled and with whom my work brought me in contact for their whole-hearted sympathy, the interest everywhere shown, and much kind hospitality.

Map showing peculiar localisation of GLOSSINA TACHINOIDES on the R.Wobe, near Geidam, Bornu, N. Nigeria.



Red Spotting = *Glossina Tachinoides*
Black Spotting = *Bush, according to density.*
Fadama = *Low ground, that may be under water at high flood.*

400 300 200 100 50 0 400 800 1200 1600 2000

SCALE OF YARDS: 660 YDS. TO AN INCH.

Bernard Mercer - Del. Nov. 1911.

Malby & Sons, Lith.

1629. P11/21. 1025. 7. 12.

Humped Cattle of the breed prevalent throughout Nigeria.

Dwarf Nigerian Cattle of a breed which is apparently immune to trypanosomiasis.

Fig. 1. Mangrove Swamp near Forcados, but typical of any part in the Niger Delta.

Fig. 2. View on the Cross River, to show the extent of the clearing around the trading factories.

Fig. 1. View on the Cross River, to show the nature of the vegetation on the banks.

Fig. 2. View on the Cross River, to illustrate the enormous fall in the level of the river during the dry season.